Industry and Power

October 1955

Jones & Laughlin Steel Corporation

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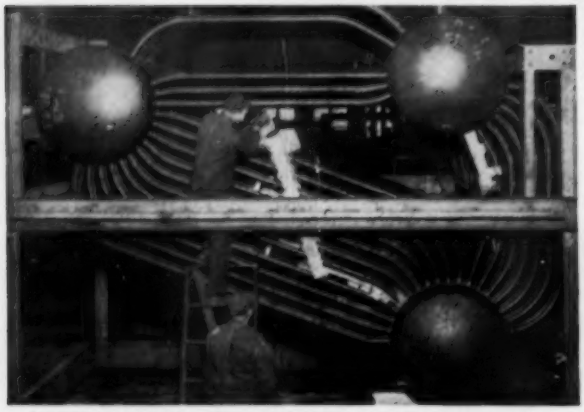
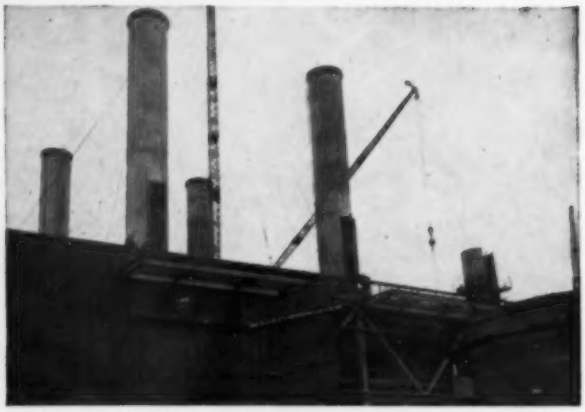
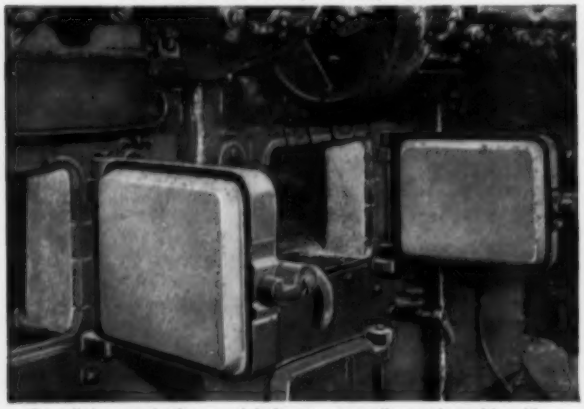
IN POWER PLANTS ON JOBS LIKE THESE:



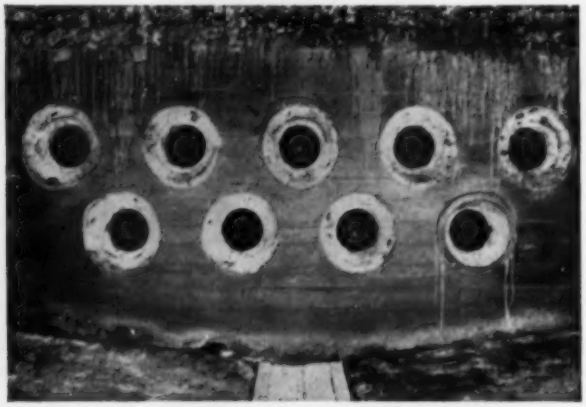
Monolithic gas-tight baffles of Refractory Concrete are easily made with a castable refractory and simple forms.



Lumnite steel stack linings keep drafts up and costly repairs due to corrosion and abrasion down.



Door linings and other special shapes are easily cast in molds with adaptable Castable Refractory Concrete.



Front wall of boiler is lined with 9 inches of Refractory Concrete—section in excellent condition after a year of service.

Castables save time and cut costs

Power-plant engineers find that castable refractories provide a fast, easy way to place or repair linings in steel stacks, breechings, boiler walls and hearths, doors, coal bunkers and ash pits. Refractory and insulating concrete made with castables can be mixed simply by adding water right on the job, and casting into place. Costs are cut and time saved because they reach service strength within 24 hours—and usually give better service than other refractories.

Castables are prepared mixes of Lumnite* calcium-aluminate cement and special aggregates selected to meet specific temperature and insulation service. They are made and sold by manufacturers of refractories, and come ready-made for many refractory jobs.

There is no need to stock large inventories of special refractory shapes—they can be cast as needed. Keep a supply of your favorite brand of Lumnite castable on hand ready for a rush job. For more information write: Lumnite Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, New York.

*"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

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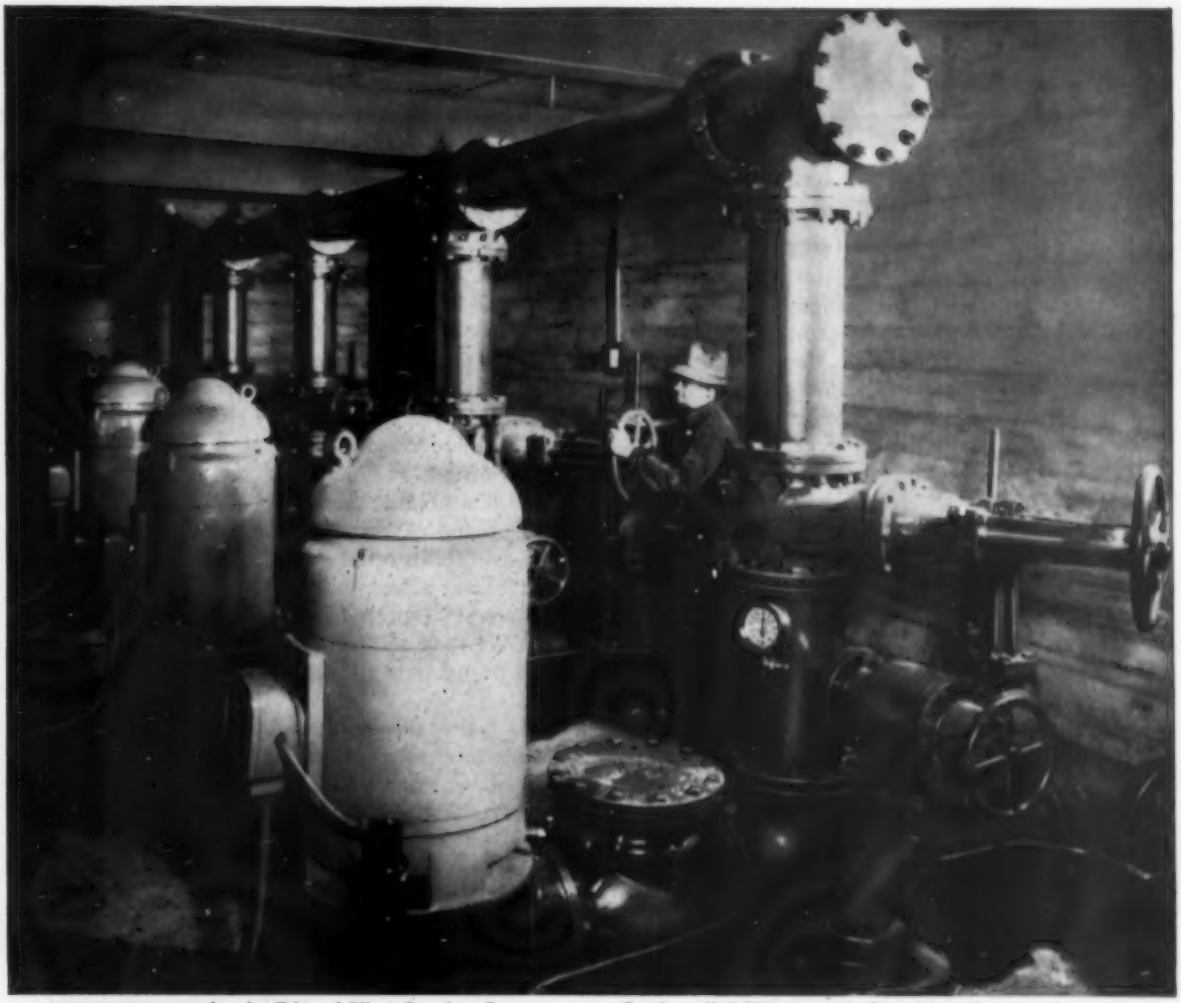

FIRE PROTECTION for the Edward Hines Lumber Company is assured by four Worthington vertical turbine fire pumps. Costly well drilling was eliminated here because the versatile Worthington pumps take water from a nearby river.

We hope these Worthington pumps are never used!

Don't get us wrong. They're good pumps. Can't be beat for always-adequate pressure, long life and real dependability.

Thing is, though, they're fire pumps — Worthington vertical turbine fire pumps — ready to supply water for the sprinkler system at the Edward Hines Lumber Company in Westfir, Oregon.

Main point — if and when they're ever needed, these Worthington pumps will go to work instantaneously, delivering enough water to quench any fire. Reason is they're always primed. And on top of approval by Factory Mutual and Underwriters Laboratories, they're guaranteed by Worthington to deliver rated capacity — whether pumping from a deep well or from a surface supply.

Our bulletin W-450-B42 tells all about the Worthington vertical turbine fire pump. Write for it today — you may be glad you did. Worthington Corporation, Vertical Turbine Pump Division, Harrison, N.J. D.S.I

WORTHINGTON

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CONSERVE GROUND WATER — IT IS A VALUABLE RESOURCE

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this month's comment

. . . from industry & power

why civil defense ? ? ? ?

why civil defense in INDUSTRY & POWER ? ? ? ?

We answer the first question, "why civil defense?", on page 41 with direct quotation from Gov. Val Peterson, administrator, Federal Civil Defense Administration. But it is in this space, where we informally chat with you every month, that we feel it is appropriate to answer the second question, "why civil defense in INDUSTRY & POWER?"

Ultimately, the answer we give rests on our abiding and basic contention that all of us are men before we are engineers. You can take that in terms of biological growth or moral responsibility. Makes little difference; we feel the conviction equally sincerely either way. The fact is that each of us is a human being before we are representative of any governmental, professional, or social order. We have said essentially the same thing before in this column. We shall probably say it again in the future when another occasion may demand.

But the present occasion — civil defense — makes these rather abstract thoughts particularly concrete, in the specific terms that relate our survival as humans to INDUSTRY & POWER's technical domain — which is your technical domain, too. Gov. Peterson establishes quite clearly the dependence of our country's success in Civil Defense on Industry's Power Services. So, as is very often true, many may owe much to a few. In this instance, the "few" are all of us with responsibility for Industry's Power Services. Every occupant of space within our country's borders relies on Civil Defense, whether he knows it or not. And Civil Defense relies on you — whether you know it or not. Part of the mission in our editorial program for Civil Defense is to make you aware of the great reliance Civil Defense does place on Industry's Power Services.

In this issue, pages 41 to 45 are calculated to demonstrate to you just how Civil Defense relies on your engineering realm. By spelling out specific action you can take, we hope *you* will be moved to act. By asking you to return the Profile Questionnaire on pages 43-44, we hope to gather in data that will move *us* to act in the most advantageous directions. That we will act is a matter of firmly established policy. We have committed to ourselves, and hereby commit to you, an editorial program to cover the aspects of Industry's Power Services that bear on Civil Defense — this program to continue as long as Congress sees fit to continue a Civil Defense agency.

We feel compelled to follow such a program simply because of this conviction of ours that we are men before we are engineers. In terms of you who read INDUSTRY & POWER, this conviction means just this: to survive as men, you who provide Industry's Power Services must respond to the particular needs of Civil Defense.

We do not mean to say that Industry's Power Services are the sole basis for success in Civil Defense. We certainly do not mean to deny the importance of any other professions. But INDUSTRY & POWER is devoted to particular professional calling — your calling. As editors, engineers, or men, we can't ignore the demands of Civil Defense upon us. We do not think you can either. That is why Civil Defense is in INDUSTRY & POWER.

Harold A. Bergen, Editor

The John Paul Taylor Publishing Co.
Commercial Bank Building, St. Joseph, Michigan

Industry and Power

Volume 69 **October 1955** Number 4

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nuclear news

. . . . about industry & power

FUSION PROCESS STILL IN THE NEWS

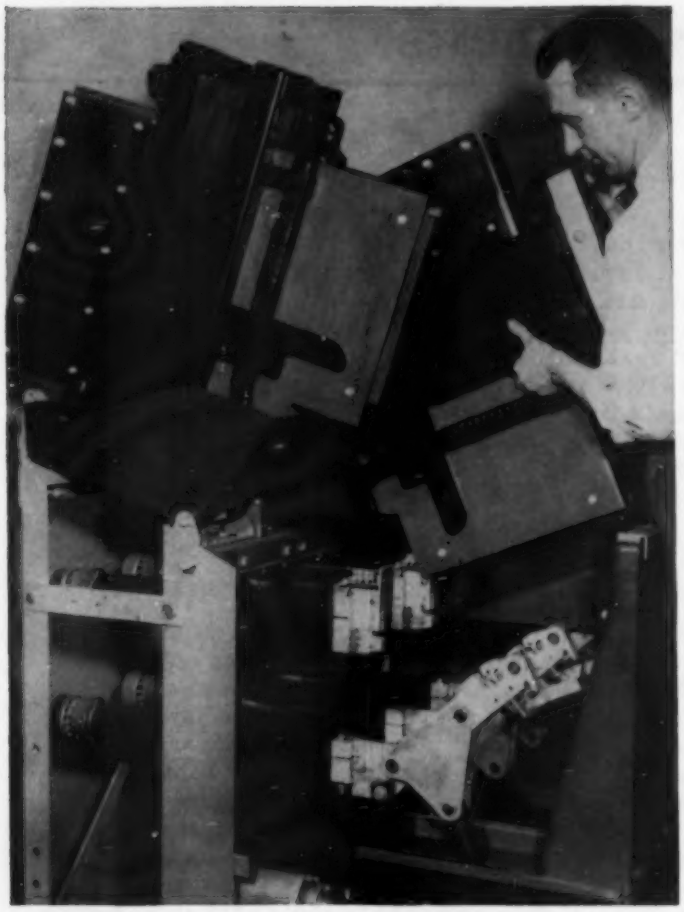
Thermonuclear ("fusion") reactions remain an item of great interest, following the hint dropped at the Geneva Conference to the effect that power from the fusion process is a foreseeable reality. The late Enrico Fermi, pioneer in harnessing the fission process, also held a patent for the fusion process. Fission was chosen over fusion as the quickest way to a weapon in the days when such choice had to be made. At least one member of the Joint Congressional Committee on Atomic Energy believes that it will take a long time to work out peaceful application of the fusion process, though he feels scientists may accidentally stumble on the answers. The AEC acknowledges that a controlled thermonuclear reaction program is one of many programs presently underway. Only encouragement a top AEC official would give, though, is the opinion that we "do not know that it is impossible."

REPORT SHOWS $151 MILLION SPENT FOR REACTORS

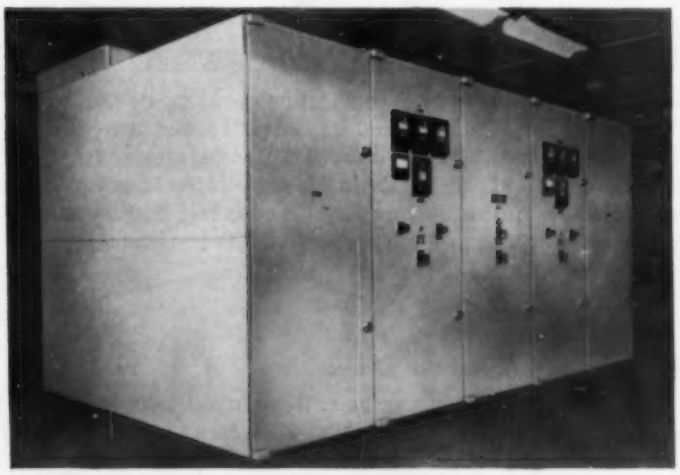
The 18th semiannual report of the AEC shows that nearly $151 million were expended for reactor development during the fiscal year ending June 30. Number of industrial study groups working with the AEC in areas of nuclear power was increased to 25, bringing the number of individual organizations now in the program to 81. Civilian power reactor programs are pursuing the following basic reactor types: pressurized water, boiling water, sodium-graphite, fast breeder, homogeneous, liquid-metal-fueled, organic-moderated, and small-sized civilian reactors. The report states "Applications to mining operations and outlying industrial plants also appear likely for packaged power reactors."

MEETINGS AND EXHIBITS BLANKET NUCLEAR FIELD

It's open season on meetings and exhibits in and about nuclear energy. The Atomic Industrial Forum and the American Nuclear Society have just wound up a Trade Fair and technical meeting in Washington. . . . Tracer Lab, Inc., is holding a symposium on applications of radioactivity in food and food processing this month. . . . The National Industrial Conference Board will convene its fourth annual conference on Atomic Energy In Industry late this month. . . . New York City is to have an atomic energy exposition running from October 20 to November 3



No cranes are required. Arc chutes pivot. Rest on fixed stop. Illustration shows 15 kv magnetic air circuit breaker.



I-T-E Switchgear in 15 kv rating. All I-T-E circuit breakers are horizontal drawout, interchangeable in like ratings.

TILTING ARC CHUTES

New I-T-E development for 15 kv air circuit breakers

The saving of time and effort which the new I-T-E tilting arc chutes make possible can best be appreciated by anybody who has ever removed the other kind. When inspection time comes, there's no crane lifting of heavy assemblies, no danger of dropping and damaging valuable parts. The arc chutes pivot back safely out of the way for easy inspection of contacts and arc plates. Only I-T-E makes magnetic air circuit breakers with this convenient, modern feature.

I-T-E Metal-Clad Switchgear is made in three basic ratings (5 kv, 7.5 kv and 15 kv), and will interrupt through 500,000 kva. Throughout the line, time-proved features add extra value. Circuit breakers are jig fitted to enclosures. Welded, rigid frames and housings can be lifted as a unit without losing alignment. Complete isolation of compartments insures safety and continuity of service.

Take advantage of I-T-E planning and engineering assistance when you order switchgear. It assures you protection with economy, plus better performance. For details, contact the I-T-E field office nearest you—look in your classified directory under "Electric Equipment." Or write for Bulletin 7004C. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY Switchgear Division

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nuclear news

. . . starts on page 6

under the joint sponsorship of the Atomic Industrial Forum, the Fund for Peaceful Atomic Development, and the Carnegie Endowment for International Peace. . . . The Power Show running in Chicago next month will have a special atomic power section. . . . The AIChE is running a Nuclear Engineering and Science Congress from December 12 to 16— a meeting that will present 292 technical papers in 50 sessions. . . . All in all, it looks like a busy nuclear season.

PRIVATE NUCLEAR RESEARCH PROGRESSES

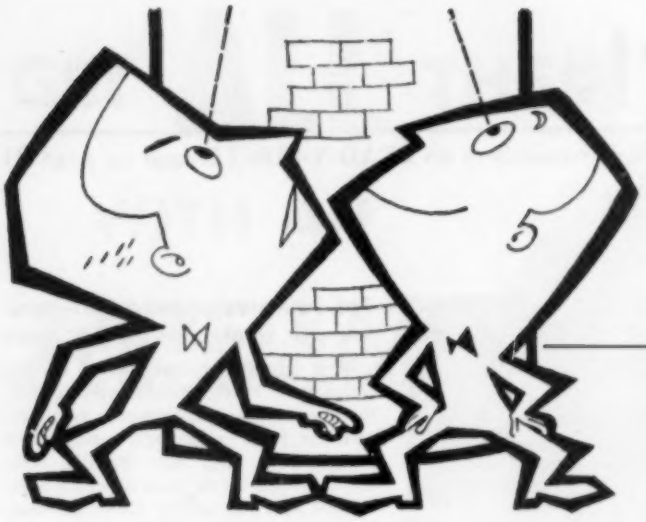
A power development laboratory and a swimming-pool-type research reactor unit will be completed at Battelle Memorial Institute by the end of the year. Both projects will be used in the development of nuclear power plants for the commercial generation of electricity. . . . Socony Mobil Oil is establishing a wholly owned nuclear research center. Socony Mobil is also a participant with seven other private companies building a nuclear reactor for industrial research. Construction of both facilities is expected to begin very soon. . . . General Electric formally opened a new radiation laboratory at its Schenectady plant.

EXPORT CONTROLS LIFTED ON ATOMIC COMPONENTS

Export licensing controls with respect to certain electrical, industrial, and scientific instruments and equipment items useful in atomic energy work have been lifted by the AEC. The Department of Commerce will institute export licensing controls on most of these items with regard to their potential strategic applications.

NUCLEAR WORK SPAWNS NEW ALLOY

A new zirconium alloy has been developed in Westinghouse's Atomic Power Division in attempts to find a structural metal capable of withstanding the intense corrosive attack of water under high temperature and pressure. The new alloy is so resistant to the extremely corrosive action of high-temperature, high-pressure water in nuclear reactors that only ten-thousandths of an inch of corrosion can be measured in a year's time. The new zirconium alloy is designated Zircaloy-2.



Your chimney never smokes any more. Did you change to another fuel?

We just changed to another kind of coal. And man! Does it make a difference! No smoke. No clinkers. No trouble. And very few ashes.

What kind of magic coal is this?

It's one of the superior quality coals produced on the Chesapeake and Ohio. But the important thing is that it is exactly right for our type of installation.

Say, I've got to look into this! We're always having boiler room trouble at our plant.

Picking the right coal is a job for an expert. I never realized there were so many things to consider. Size, moisture, sulphur, ash softening temperature, etc., as well as BTU's.

Why don't you write to the C&O coal people? Tell them your problem and describe your boiler equipment. They'll help you find the very best coal for your particular condition.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

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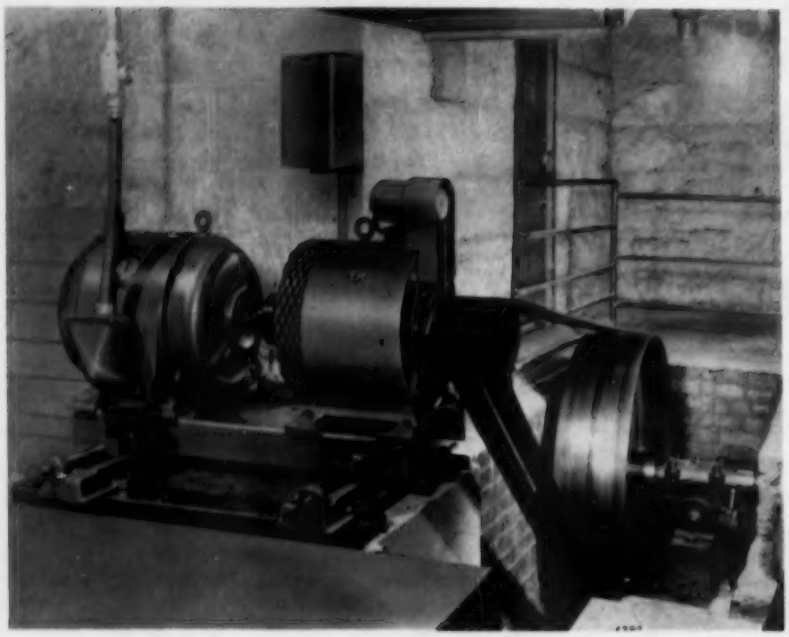
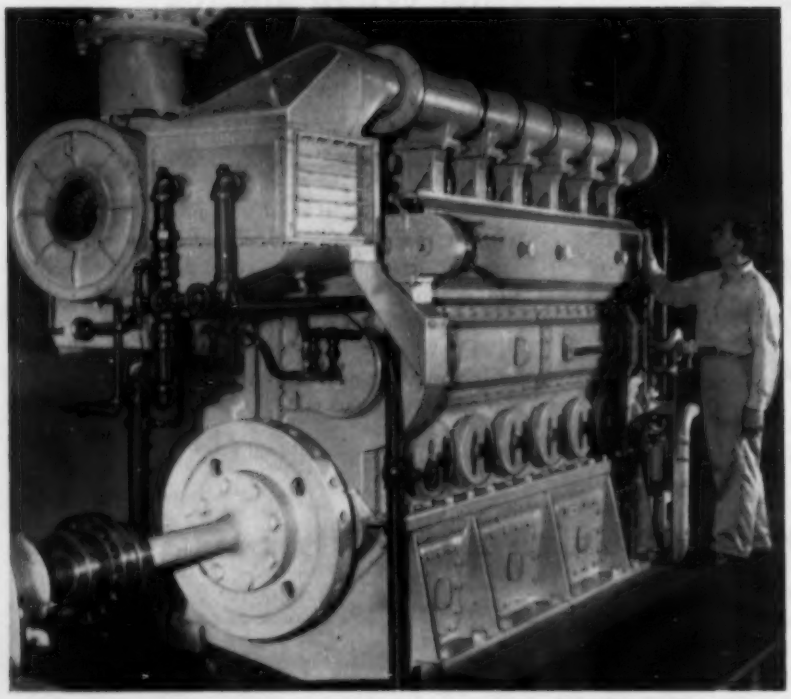
new products

. . . just circle key numbers on READ-N-CIRCLE card on page 81



700-General-purpose drive — precise, stepless adjustable speed

New adjustable speed drive can be coupled or belted to an existing motor to control speed within ± two percent for fans, centrifugal pumps, and compressors. Can also handle constant-torque loads such as mills, conveyors, and machinery. Complete system consists of an "Ampli-Speed" Drive, a wall-mounted Magnetic Amplifier Speed Control, and a control rheostat mounted at any convenient location. Air-cooled unit uses a d-c-controlled magnetic connection between input and output shafts. Speed can be changed by turning the control rheostat knob, or by automatic combustion, pressure, or liquid-level controls. Speed changes are stepless. The drive is designed for motor speeds of 870, 1150, or 1750 rpm. Horsepower ratings range up to 95 horsepower for fan-type loads and 75 horsepower for constant-torque loads. ELECTRIC MACHINERY MFG. COMPANY.



701-Medium-speed engine runs on almost any fuel

Four-cycle, 400 to 1400-horsepower, heavy-duty, continuous-service engine uses residual, crude and distillate oils, natural gas, sewage gas, manufactured gas, or propane. High structural strength reduces foundation and installation expenses, and makes the engine adaptable for trailer or rail-car mounting. Crankshaft is suspended from the frame, which leaves the engine base as a unit for supporting the engine and mounting it on the foundation. The base serves as the oil sump for stationary applications. The welded steel engine frame is fitted with cast iron cylinder liners. Water jackets are cast integral with the liner, which permits withdrawing the piston, connecting rod, and liner as a complete assembly to simplify maintenance. Engine is designed for power take off from either end, and can be equipped with standard clutches, hydraulic couplings, torque converters, or other power take off equipment. Engine operates smoothly, has low fuel consumption

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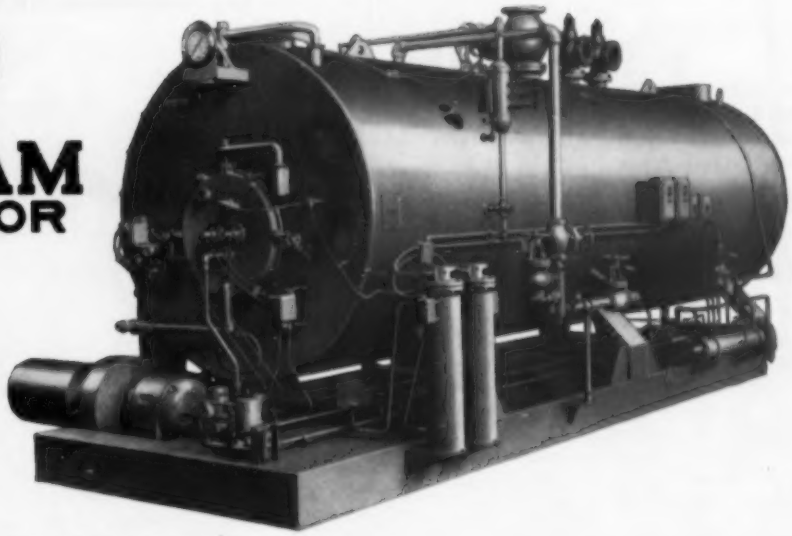
WITH AN AMESTEAM GENERATOR



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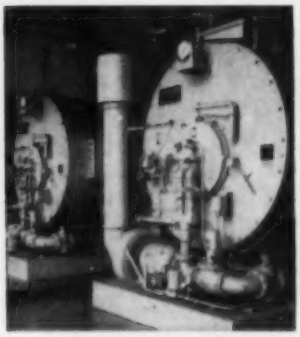
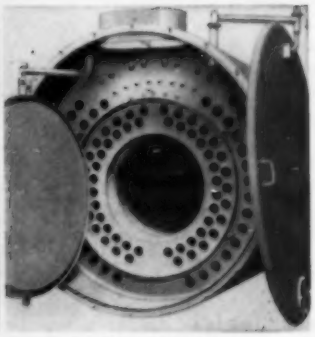


FULLY ASSEMBLED

All piping, wiring and operating parts completely assembled and tested at factory — units shipped in ready-to-fire condition!



EASY TO CLEAN

Ames-designed davit hinged flue covers and baffle provide quick and complete access to the furnace and all tubes.

SAVINGS IN FIRST COST!

Your purchase price includes complete unit — no hidden "extras" to buy later on!

SAVINGS AT INSTALLATIONS

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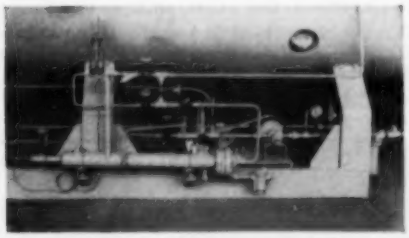
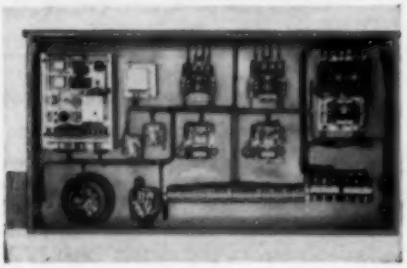
SAVINGS IN OPERATION

A minimum of supervision — lower manhour requirements for maintenance — easily replaced inexpensive plastic refractories — 80% thermal efficiency.



AMPLE ROOM

underneath for servicing auxiliary equipment. Control panel at eye level.



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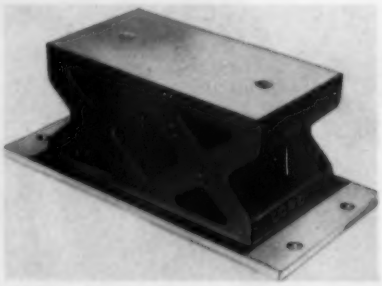
new products

. . . just circle key numbers on READ-N-CIRCLE card on page 81

and high power output. Available in 6- and 8-cylinder models, the naturally aspirated and exhaust turbocharged line covers a range from 400 to 1400 horsepower. WORTHINGTON CORPORATION.

702-Hydraulic vise speeds maintenance

New hydraulic vise is controlled by two simple foot pedals—one to apply power and one to release. Frees operator's hands for handling and positioning. Stop control is adjustable so that vise grips and holds work with a single power stroke. Features a new hydraulic pump that uses a replaceable cartridge containing main check valve, release valve and bypass relief valve. This eliminates a common hydraulic-vise maintenance problem. Vise can be fully opened in four seconds. Maximum hydraulic pressure is 7000 psi, maximum jaw pressure is 4000 pounds. Jaw width is four inches, opening six inches. THE COLUMBIAN VISE & MFG. CO.



703-Lattice mountings solve vibration problems

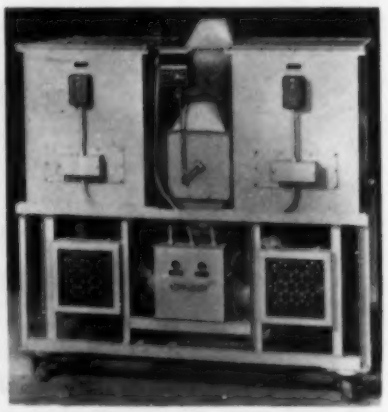
Bonded-rubber lattice mounting provides a high degree of vibration and noise isolation, particularly in the low-frequency, high-amplitude range. This new mounting is available in capacities ranging from 250 to 3000 pounds and static deflections from ¼ to 1½ inches. Mounting has a lattice rubber section that is bonded to horizontal steel plates at top and bottom. Where the operating speed of the machine is extremely low, mountings may be installed in series for even more effective vibration isolation. LORD MANUFACTURING COMPANY.

704-Hand spreader for ice-melting pellets

Ice- and snow-melting chemical pellets now come in 300- and 500-pound reinforced fiberboard containers. MELT has 30 times the thawing capacity of salt. Included with each 500-pound drum is a mechanical hand spreader. Leaves no residue and will not harm vegetation, rubber, asphalt, or concrete. Phosphate-type rust inhibitor interspersed with the pellets protects metal from deterioration. Also comes in 25-, 50-, 100-, and 200-pound drums. CHEM INDUSTRIAL CO.

705-Thermostatic absorption-type dehumidifier

Automatically regulated dual-tower absorption-type, heavy-duty dehumidifier uses silica gel as drying agent. Maintains humidity as low as 10 percent in areas up to 60,000 cubic feet over a wide temperature range. Has dry air output of 150 cfm and can remove four to five pounds of water per hour. Silica gel is regenerated automatically by an electric heating element. A four-way valve alternately directs the air from one silica gel tower to the other, so that one tower is regenerated as the other dehumidifies. Built-in or remote humidistat control can be provided. DRYOMATIC CORPORATION.



FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 81.

706-New 600-v. current transformer suitable for panelboards

New 600-volt current transformer is suitable for many panel or switchboard applications. Constructed of molded butyl, which serves as insulation, support, and casing. Type JCP-

BETZ • *A Great Name*
In Water Conditioning

"Prescriptions" by the truckload!

Solving industrial water conditioning problems effectively and *economically* requires exacting engineering techniques.

There are no stock answers . . . no stock chemical treatments.

We realize this perhaps more than anyone. In fact, we make a business of it.

For example, each year at our mixing and formulating plants in Pennsylvania, Texas, California, and Quebec, we blend and ship thousands upon thousands of different "prescriptions", each specifically job-engineered to solve some individual water conditioning problem for industry. Because we feel it is so important to "tailor-make" our formulations, each of our plants actually performs the function of a giant industrial pharmacy.

The blending and shipment of our chemical formulations is, however, only one important part of our *completely-individualized* water conditioning service. Individual investigations, plant control methods, daily testing programs, periodic checkups, analyses of water samples, and regular engineering reports all combine to provide a water conditioning service that is complete in every detail.

The end result of individual attention to individual problems is obvious . . . the assurance of a plant (perhaps your own) operating at peak efficiency, free from water problems.

A 20-minute, no obligation discussion of your plant water problems with a Betz District Engineer is the best investment in time you can make. Call him in today.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

Circle 148 on READ-N-CIRCLE card for more data

new products

. . . starts on page 10

O transformer is suitable for operating ammeters and wattmeters in applications where revenue-metering

accuracy is not required. Can be operated with a bare primary conductor on circuits up to its rated voltage, or can be applied to higher-voltage circuits when used with an insulated primary conductor. Rated for 50- to 60-cps service, the transformer provides seven standard primary current ratings from 100:5 to 800:5 amperes inclusive. Designed for continuous operation at 100 percent of rated current in 55 °C ambient temperature without exceeding the allowable 30 °C rise. The core of silicon steel is wound in a continuous strip to take full advantage of the low core losses and high permeability that characterize this type of steel. The core is annealed after winding to relieve any stresses. GENERAL ELECTRIC COMPANY.

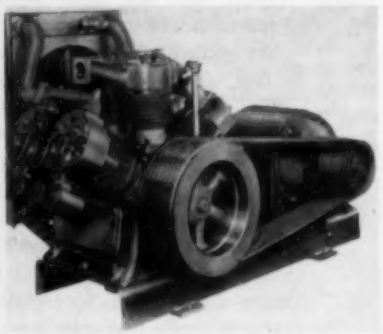
707-Warns of mechanical failures

Portable electronic instrument for detecting faults and bearing failures in motors and machinery is now available. Instrument conveniently and reliably locates mechanical troubles soon enough to confine repairs to a minimum. Enables operator to hear warning sounds which may not otherwise be heard because of frequency, intensity, or surrounding noises. Ex-

act source can be traced without having to take down entire unit. Weighs only 2½ pounds and is easily operated. Can also be used for the detection of flaws in metals, leaks in pipes, and valve defects. Has been used in measurement of volume of flow in pipelines. JOHN OULD, (U. S. A.) LTD.

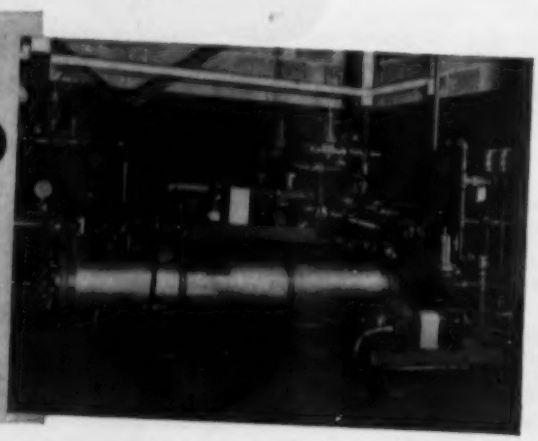
708-Air-cooled compressors require minimum attention

Two-stage, air-cooled, electric-motor driven compressors (50, 75, and 100 horsepower) have displacements of 260, 415, and 550 cfm at 125 psi operating pressure. The new three- and six-cylinder compressors have a balanced design that reduces vibration and noise to a minimum. They are compact, lightweight, and require a minimum of attention. Alloy-iron cylinders are cooled by a high-speed, belt-driven fan that draws air through a sectional-core intercooler. Each bank of cylinders has individual intake filters. Forced-feed lubrication



uses positive plunger-type oil pump. Standard equipment includes a Dual-Control, which gives a choice of start-and-stop duty of both motor and compressor, or a continuous running of motor with intermittent compressing and unloading. LE ROI DIVISION, WESTINGHOUSE AIR BRAKE COMPANY.

2 ENCO FUEL OIL UNITS *in this plant*



Here is a typical 2 unit installation of Enco fuel oil pump sets—selected to take care of all the requirements of a building materials manufacturer.

The Large Unit has 2 pumps and 2 heaters, completely automatic and arranged for operation with either heater, or either pump—or both. With one heater and pump the capacity is 11 gpm Bunker C oil at 300 psig pressure, and temperature rise from 90F to 230F.

The Small Unit is for cold starting up—has no heater. The capacity is 3 gpm of No. 2 oil at 300 psig pressure.

All Enco sets are individually designed, each for specific plant conditions—for easy installation, low maintenance and minimum carefree operation.

Complete details including the 10 important features of Enco fuel oil heating and pumping sets are given in Bulletin OB53. Copies gladly sent upon request.

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.
In Canada: Rock Utilities Ltd., 80 Jean Talon St. W., Montreal, P. Q.
Pulsar Enterprises, 378 York St., London, Ontario
EC-507

Circle 118 on READ-N-CIRCLE card for more data

709-More-weatherproof jacketing completely salvageable

Series of eight ribs rolled into the underlapping edge of aluminum jacketing permits a more positive weather seal. LAP-SEAL also saves labor, since the two-inch ribbed edge elimi-

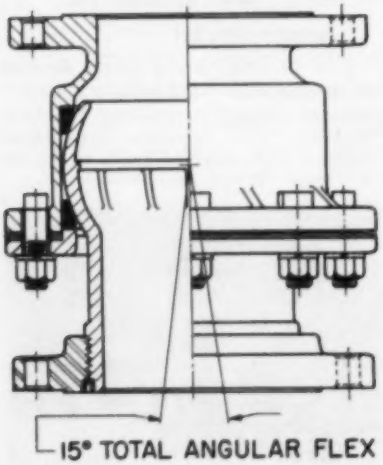
nates measuring for circumferential lap. Jacketing is easy to handle, easy to install, easy to attach, maintenance free, and completely recoverable after disassembly. CHILDERS MANUFACTURING COMPANY.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 81.

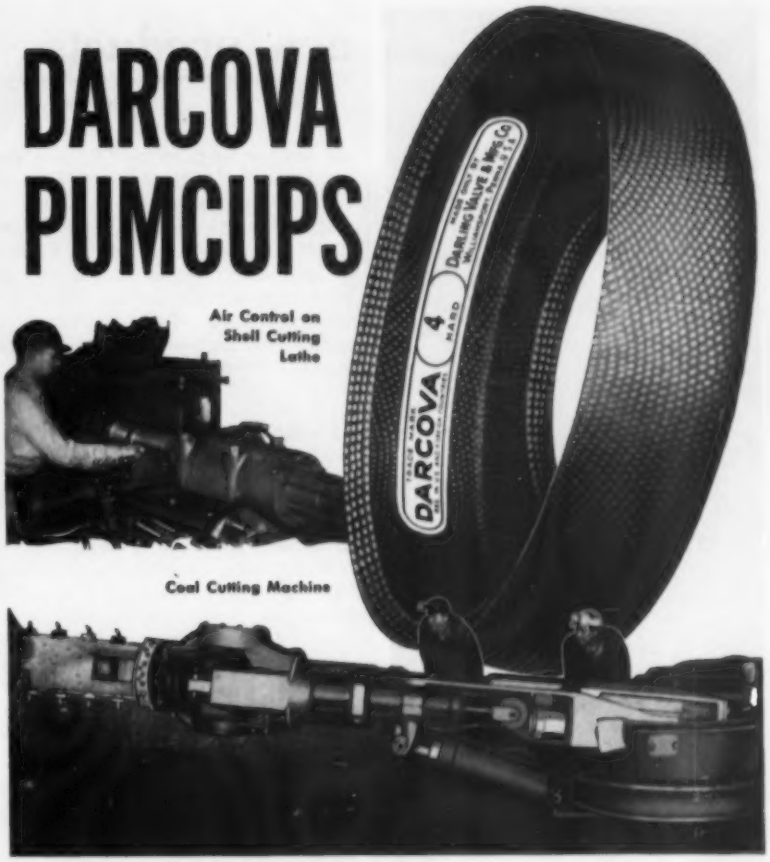
710-Lighter piping ball joints are stronger

Ball joints in 8-, 10-, and 12-inch sizes may now be ordered in steel or Bar-Ductile metal — a new ductile iron metal that combines the strength of steel with the wearing qualities of malleable iron. Flanged-end joints are available with 150- or 300-pound flanges. Joints with welding ends are suitable for 600-psi steam and operat-



DARCOVA PUMCUPS

Air Control on Shell Cutting Lathe



Coal Cutting Machine

The most efficient piston packing for air and hydraulic mechanisms

MORE and more plants are adopting Darcova Pumcups as the standard packing for air and hydraulic cylinders in machine tools, presses, hoists, lifts, rams, pusher mechanisms, controls, regulator valves, spraying equipment and various types of machinery . . . using air, oil, water and other fluids.

There are two basic reasons why Darcova Pumcups have proved to be more efficient: (1) Texture engineered Pumcups outlast most other piston packing at least 3 to 1. (2) Pumcups operate at full efficiency *throughout* their entire life span.

Fewer shutdowns, lower operating costs and longer cylinder life . . . are some of the advantages of Darcova Pumcups. Send for all the facts. Write for Bulletin No. 4502 on Pumcups for air and hydraulic mechanisms.

DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
Williamsport 9, Pa.

PUMCUPS

Circle 127 on READ-N-CIRCLE card for more data

unequaled
for Flexible
service
For what purpose do you use flexible metal hose? To control expansion, contraction, vibration . . . to solve a misalignment, a conveying problem?
Whatever your application, you are buying flexible service. For your dollar's sake, it is well to know that Atlantic metal hose returns more flexible service than any other hose. Your own performance records will prove it.
For every application, there is an Atlantic flexible metal hose that is JOB TESTED AND CERTIFIED!
Write for Catalog 500 . . . See our catalog in Sweet's File for Product Designers.
Manufacturers of Seamless and Interlocking Flexible Metal Hose in Steel, Stainless Steel, Monel, Bronze . . . Sizes ⅛"-36" I. D. with appropriate fittings.
ATLANTIC
METAL HOSE CO., INC.
324 Dyckman Street
New York 34, N. Y.
Circle 135 on READ-N-CIRCLE card

new products

. . . starts on page 10

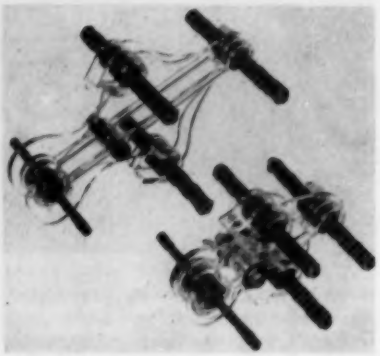
ing temperatures to 1000 F. Both patterns may be equipped with a special composition gasket for gasoline, oil, water, non-corrosive chemicals, and steam up to 300 psi. Safety features include high resistance to fire and 15-degree angular flexing, which provides for tank settling, piping alignment, and thermal expansion. BARCO MANUFACTURING COMPANY.

711-Air diffuser gives draftless air conditioning

Standardized, smaller versions of the patented Multi-Vent units that have been used for a long time in railroad cars, hospitals, and laboratories are now available. "Modular" Multi-Vent is a perforated ceiling panel that introduces air vertically and at low velocity into the working area. The perforations reduce the high velocity of air in the duct from between 1000 and 1500 feet per minute to 40 or 50 feet per minute. Suitable for ceilings with various combinations of acoustical treatment, illumination, fireproofing, and radiant heating. Besides being draftless, the unit can be completely concealed from view. Does not interfere with light fixtures. Available for the most widely used types of ceilings — metal pan, plaster and acoustic tile — as well as for exposed metal ducts. MULTI-VENT DIVISION, PYLE-NATIONAL COMPANY.

712-Cheaper power line maintenance

Plant electricians can now take advantage of improved performance and savings with power lines because of a new type of cable and suspension. Instead of spiralling the insulated aluminum conductors tightly and binding them to the supporting messenger cable, the new Hendrix system employs acrylic plastic insulating clamps at approximately 30-foot intervals. These hold the conductors closely spaced and attached to the messenger. Two sizes, similar in design, space the conductors three or six inches apart equilaterally. The 3-inch spacing is good for operating voltages less than 5000 volts. The 6-inch spacing is good for those over 5000 volts, although the large clamp may be used on the lower primary voltages at 40-foot intervals. When working on the system, all four wires are in front of the operator. There is no danger of backing into another wire. Circuits can be worked hot, using only the ordinary safety methods. HENDRIX WIRE & CABLE CO.

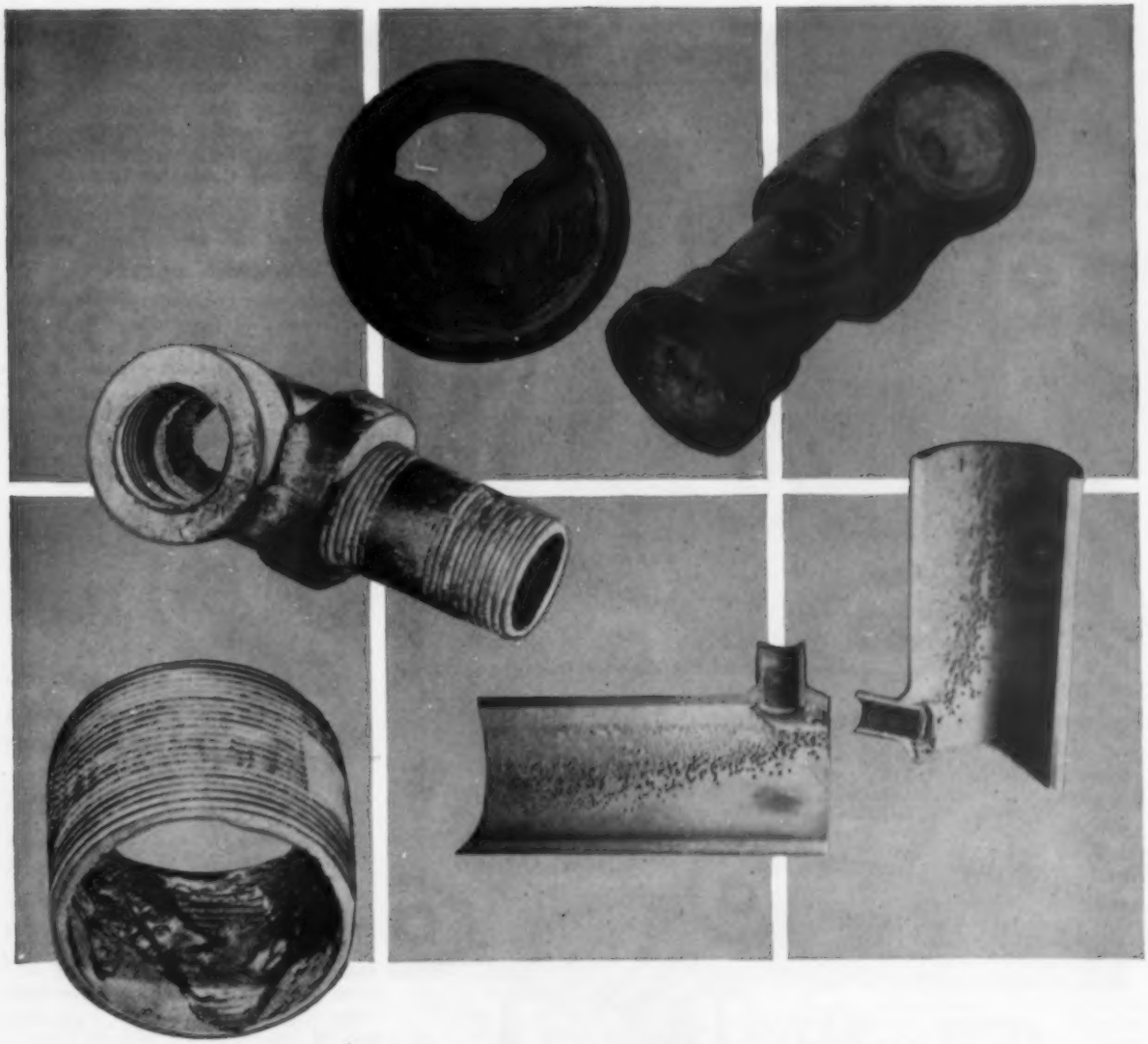


FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 81.

713-Small relay controls 60-ampere loads

Low-current, low-power devices or circuits such as an ordinary photocell are enough to activate the new Micrelay. This sensitive instrument controls high-current loads up to 60



WHAT'S YOUR TROUBLE?

Each of these destroyed parts had to be taken out of service because of incomplete or inadequate water treatment. Replacement meant loss of steam production . . . new equipment expense . . . added labor-repair costs.

DEARBORN COMPLETE WATER TREATMENT SERVICE eliminates this by providing trouble-free water—a vital necessity to every user of industrial steam. Dearborn's many years of leadership in the field of water treatment will help keep your power plant operating economically.

CALL ON YOUR DEARBORN SALES ENGINEER for (1) analysis of raw water (2) recommendation of test procedures (3) proper treatment (4) a manually or automatically controlled feeding system.

Dearborn®

combatting corrosion wherever it occurs

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. INP
Chicago 54, Ill.

Please send me
- ☐ Internal Treatment Bulletin 5000
- ☐ Filmeen Bulletin 5013-A
- ☐ Dearborn "659" Bulletin 5008
- ☐ Have a Dearborn Sales Engineer call.

Name.....
Company.....
Position.....
Address.....
City..... *Zone*..... *State*.....

Circle 150 on READ-N-CIRCLE card for more data

Full 180° Visibility
Accuracy to ½ of 1%

You get full 180° visibility with the new Jerguson Truscale Gages with the Convex Scale. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can bring your liquid level down to the control room floor, or other remote point . . . and can see it from anywhere in the room . . . can check a whole line-up of Truscales with one look from any point.

Truscale is really accurate too . . . sensitive to ½ of 1% of scale reading. Simple trouble-free construction. Available with signal horns, lights and up to six repeaters for other auxiliary points.

New design boiler water gage gives maximum visibility

Jerguson's unique offset single piece gage chamber gives you more inches of visibility with no blind spots. Special valve with horizontal loop keeps the strain off the gage under varying conditions of expansion and contraction.

Send for complete data on Jerguson Convex Scale Truscales . . . and Boiler Water Gages.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Follsway, Somerville 45, Mass.

Offices in Major Cities
Bailey Meters & Controls, Ltd., London, Eng.
Controle Bailey, Paris, France

Circle 124 on READ-N-CIRCLE card

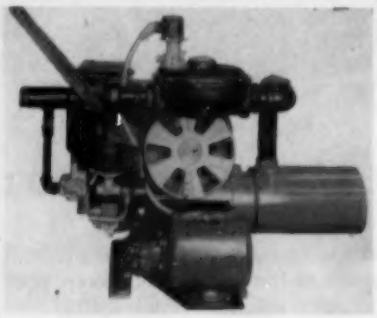
new products

. . . *starts on page 10*

amperes or three horsepower at 115 volts ac, from devices or circuits with impedance values ranging from 10 megohms (3 microamperes) to 100,000 ohms. Also available for control of loads up to 35 amperes or two horsepower at 115 volts, ac, and may be had for either normally open or normally closed operation. Relay has all-electronic construction and only one moving part in entire unit. Suitable for automatic inspection and sorting, liquid-level or flow control, temperature control in conjunction with thermoregulators, voltage current and wattage regulation with contact-type meters, machine, motor, and signal control. EBERT ELECTRONICS CORPORATION.

714-Precision gas burners cost less

Six new gas and gas-oil burners with easily set accurate air-to-gas ratios, high efficiency, and dependable controls are now available at prices 30 to 40 percent lower than previous models. Capacities range from 720,000 to 8,600,000 Btu. Can be used for gas, light oil (No. 2 grade) and gas, or a



combination of heavy oil (No. 5 grade) and gas. Secondary air is supplied by the burner, so it does not depend on stack draft. Air is correctly metered for highly efficient combustion. Oil and gas interchange is accomplished by flipping a switch. CLEAVER-BROOKS COMPANY.

715-One primer for most paints

Primer that dries in 10 minutes at 85 F reduces application costs. For use over wire-brushed, rusty steel, sandblasted steel, and clean cold rolled (bright) steel. The primer shows good resistance to acids, alkalies, and solvents. It improves topcoat performance of maintenance vinyls, phenolics, alkyds, chlorinated rubbers, one-package neoprenes, oil-base paints, and furans. Compatibility with all these topcoats eliminates the need of carrying many different primers in stock. CARBOLINE COMPANY.

716-Small two-circuit limit switch boasts high capacity

Small-size, heavy-duty limit switch for control of two independent circuits has a sealed construction and high electrical capacity plus adjustability. Equipped with a roller-arm actuator which can be field-adjusted through 360 degrees, with positive locking in any position. Actuation can

be clockwise, counter-clockwise or in both directions. Electrical rating is 10 amperes at 120, 240, or 480 volts, ac; pilot duty rating is 0.2 amperes at 115 volts dc, 0.1 ampere at 230 volts dc, and .04 ampere at 550 volts dc. Operating force is three pounds maximum, full over-travel force is six pounds maximum, and release force is one-half pound minimum. MICRO SWITCH DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 81.

717-New deflection indicator guards shafted machinery

Deflection indicator for use on any equipment that requires prompt detection of relative motion is adaptable to any shafted machinery. Consists of two compact inductor coil pickup units which operate on a 60-cps, 110-

HOW TO BUY V-BELTS

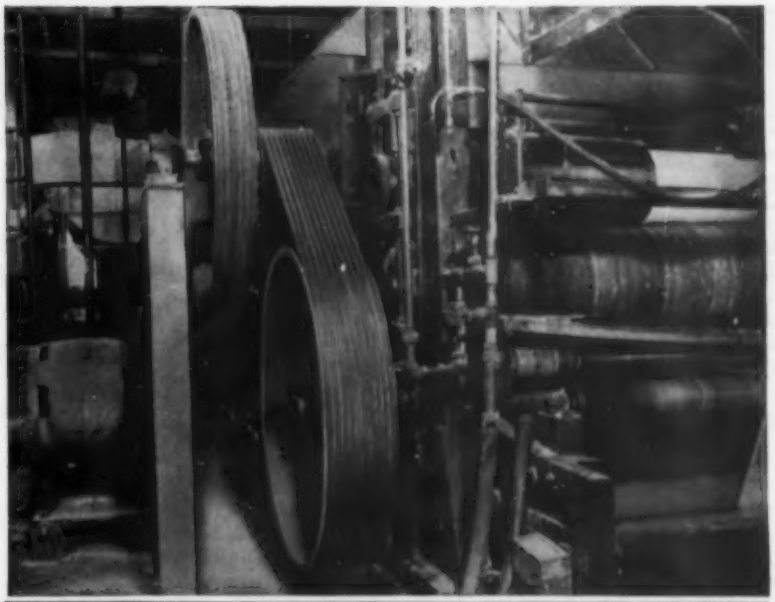
FOR TOUGH, RUGGED DRIVES

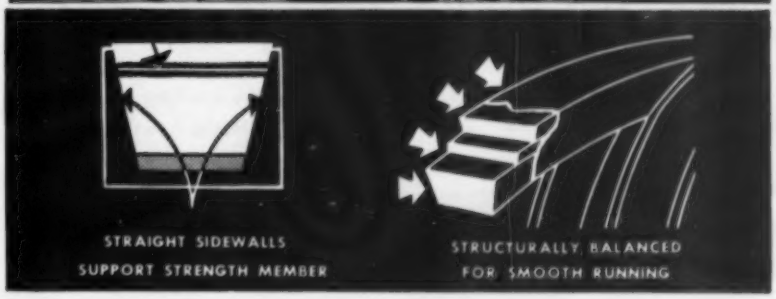
. . . and get "More Use per Dollar"

Look for a V-belt construction that provides longer life under shock loads . . . extra strength with the use of the right synthetic strength member.

Precision balance of all parts of the V-belt makes for a smoother running drive, fewer matching problems . . . and longer life for all belts on a multiple drive. Belt strength members of super-strength cords should be correctly positioned in the neutral axis section of the belt so as not to stretch or compress unnecessarily as the other parts of the belt are flexed in use. Straight belt sidewalls help support strength members in a straight line, permit all cords to pull equally . . . deliver their full share of power. You get more grip, less slip because the belt presses tightly against the sheave grooves when rounding pulleys.

Specify by name the V-belt engineered to give you extra strength and extra pulling power . . . specify R/M Super-Power V-Belts.





R/M SUPER-POWER V-BELTS

With these superior V-belts you get up to 40% more power capacity, or fewer belts can be used on the same drive, thanks to R/M's new synthetic super strength member. They provide greater elastic resistance to shock loads and permit virtually no stretch. R/M Super-Power V-Belts are oil-proof, non-spark, heat resistant. You get the balanced combinations of features you need for more power on rugged multiple drives. Let an R/M representative show you how R/M Super-Power V-Belts, as well as Condor V-Belts, last longer on the job . . . give you "More Use per Dollar".

RM-818

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

Circle 134 on READ-N-CIRCLE card for more data

new products

. . . starts on page 10

volt power source, and a control assembly. Has no electronic tubes. Operates on a balanced bridge principle. Control unit can be located at any convenient point. Time delay prevents false warnings caused by vibration or deflection of short duration. Can be operated in any position. Requires minimum installation and maintenance. ALLIS-CHALMERS MANUFACTURING COMPANY.

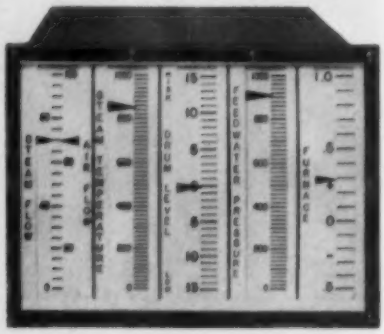
718-Single-solenoid hydraulic valve offers automatic control

Single-solenoid pilot-operated hydraulic valve for automatic hydraulic circuit control is subplate type for panel mounting. Designed for full 3000 psi, the valve is available in ½-, ¾-, 1-, 1¼-, and 1½-inch sizes. Meets all JIC requirements. Full capacity

is rated at 3.6 gpm at 15 feet per second. Heavy continuous-duty type solenoid is shock resistant and has low power consumption. Single solenoid has spring return, and operates two positions on the four-way valve. RIVETT LATHE & GRINDER, INC.

719-Small gauges are illuminated

Small-size receivers, draft, pressure, and temperature gauges that permit more compact instrument panels have scales only five inches high. Yet, they are easy to read — even from a distance. Each gauge or receiver is an independent, self-contained unit and may be grouped with as many as eight other units in a single case or mounted individually. Full-sized diaphragm, bellows, or helix elements are used for high accuracy. Bellows units directly measure pressures up to 100 psi. Illuminated scales are standard. On most models, duplex units are available with two pointers indicating two separate functions on a single scale. REPUBLIC FLOW METERS COMPANY.



720-Film-type heating elements give uniform heating

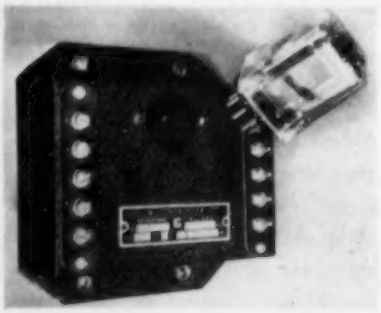
Uniform temperature and efficient heat transfer (as high as 60 watts per square inch in special designs) are features of "Heat Sheets" — UL approved, film-type heating elements. Lightweight and flexible, they can be wrapped around surface as small as one-inch in diameter. Completely unaffected by temperatures up to 600 F, by solvents, and by most acids. Available in sizes up to 36 x 42 inches, and in resistances from 10 to 10,000 ohms per square. ELECTRICAL COATINGS, INC.

721-Breathers for starters

Stainless steel universal breather and drain for use on explosion-proof combination starters and circuit breakers and other equipment housings in Class I, Groups C and D hazardous locations allows passage of three to four times more air than standard types. ECD breather and drain ventilates housing by allowing constant circulation of air. Drains off accumulated condensed water. Can be installed by screwing into hubs or holes that have five or more threads tapped in them for conduit. CROUSE-HINDS COMPANY.

722-Floatless liquid-level control

Operating coils of this floatless liquid-level control are completely covered with a moisture-proof compound. This eliminates any possibility of damage due to unusually moist conditions. Operating relay is plug-in



type, two-pole double throw, which permits using one type of controller for any type of application. Clear plastic case permits inspection of contact points at all times. Easily replaceable. Available in NEMA 1 or NEMA 4 cases, or as a bare chassis. GULOW CONTROLLER CO.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 81.

723-Worn stairs made better than new ones

Extruded aluminum safety treads level worn stairs and make them nonskid. Eleven abrasive ribs dovetailed into the Stairmaster safety treads insure slip proofing. This technique of repairing treads is less expensive than replacing the treads themselves and rebuilding the stairway. Available in standard widths to fit all stairs and factory cut to length as required. Treads are drilled for easy installation. Leveling compound is available for badly worn steps. WOOSTER PRODUCTS INC.

DYNAMATIC®

ELECTRONIC CONTROLS

in Conjunction with Dynamatic Eddy-Current Drives, Couplings, and Brakes, Provide Automatic Speed Control for a Wide Range of Industrial Applications

Basically, Dynamatic eddy-current electro-magnetic equipment is used to convert constant speed rotation into adjustable speed, or to produce constant speed rotation from a varying speed source. In a wide variety of industrial speed control applications, this equipment offers the advantages of rapid response, a wide range of stepless adjustable speeds, quiet operation, low power loss, low maintenance cost, and adjustable speed from an AC power source.

Dynamatic electronic controls with Dynamatic eddy-current equipment provide a simple, low-cost means of remote speed control for many specialized applications, such as pre-set multiple speeds, threading, inching or jogging, controlled acceleration, torque limiting, cascading, speed matching, and others.

To get the story of modern industrial speed control, send for your copy of Dynamatic's new illustrated Electronic Control Bulletin.

This New Electronic Control Booklet Covers Construction, Performance, Maintenance

Here's the story of Dynamatic electronic controls and their application to Dynamatic rotating equipment. Generously illustrated with numerous circuit diagrams. Contains valuable service hints. It's free—just ask for Dynamatic Bulletin EC-1.

EATON

DYNAMATIC DIVISION
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new bulletins

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400-Pneumatic sewage ejectors

How to determine head and capacity requirements for sewage lift stations is discussed in detail in Manual 4000-C2. Both mechanically- and electrically-controlled units are described. Detailed air piping diagrams are included. Forty-eight pages. YEOMANS BROTHERS COMPANY.

401-Machine plastering saves time

How to break the plastering bottleneck by machine application of vermiculite plaster and acoustical plastic is described in Bulletin PA-29. Illustrations show the application technique, which can be used in all types of construction. Four pages. ZONOLITE COMPANY.

402-How to build better masonry

Recommended practice covering materials, proportioning, mixing, and laying of units is offered in Bulletin WP6.55-35M. Three essentials to better masonry and four essentials to better mortar are given with quantity reference tables. Twenty-four pages. UNIVERSAL ATLAS CEMENT COMPANY.

403-Sewage reference manual

Reference manual for engineers interested in proper disposal of sewage and industrial wastes is now available. Bulletin 240 contains complete list of apparatus used for the testing and control of sewage effluent by American Public Health Association methods. Eight pages. PRECISION SCIENTIFIC COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 81.

404-Miniature numerical indicator

High-speed numerical counter that accurately indicates any physical quantity converted into a corresponding voltage through conventional sensing devices is described in Bulletin 1054-B6. Indicating mechanism can be switched from one type of sensing device to another to indicate numerical values of many other variables. Can be modified for use on control functions. Several applications and accessories are described. Four pages. STREETER-AMET COMPANY.

405-Control pipeline surges

Magnilastic Hydropads for elimination of water hammer, and dampening of pulsations induced by reciprocating pumps are described with engineering data in Catalog 52. Units can also be used as accumulators in hydraulic systems and for accommodation for excess fluid volume that results from thermal expansion. A table on determination of expansion in pipelines heads a section on expansion joints. Thirty-six pages. COOK ELECTRIC COMPANY.

406-Electric heating for liquids

Multipass electric heaters for heat-transfer fluids and viscous liquids are described with the aid of illustrations and skeletonized views in Bulletin 102.1. Typical flow diagrams are also given with complete specifications and operating ranges. HYNES ELECTRIC HEATING DIVISION, TURBINE EQUIPMENT COMPANY.

407-Quick coupling for stainless pipe

New industrial fitting for corrosive applications that enables joints to be made in jig time is described in Bulletin 1055. Available for standard pipe and tubing in one- through four-inch sizes. Four pages. LADISH CO.—TRI-CLOVER DIVISION.

408-Controller action improved

Supplementary control device that anticipates fuel needs of controlled heating equipment and enforces straight-line control on the process variable, is explained in Bulletin F 5795-2. Heat transfer lags are anticipated and compensated for by a simple electrical network and relay circuit synchronized with the measuring system. Accuracy of temperature reading at control point is unaffected. Two pages. WHEELCO INSTRUMENTS DIVISION, BARBER-COLEMAN COMPANY.

409-Transmission data tables

Book of useful engineering information such as procedures for calculating horsepower of spur, helical, herringbone, worm, and zerol gears are offered in Bulletin G-655. Tables of engineering data such as hardness conversion, recommended keyways, stresses in shafts, determination of moment of inertia, speed ratios of planetary gearing, and horsepower charts make this book a must for plant engineers interested in power transmission. Seventy pages. PHILADELPHIA GEAR WORKS, INC.

410-Read about longer battery life

Storage-battery selection, charging, handling, maintenance, inspection, and testing for switchgear control are covered in the Plus-Performance Plan. Performance can be improved and battery life extended by as much as 50 percent. Read how in this collection of articles, specifications, charts, record systems, manuals, and bulletins. GOULD-NATIONAL BATTERIES, INC.

411-Belt-driven fan data

Belt-driven fans for commercial, light-duty and heavy-duty industrial exhaust applications are described in Bulletin 7214. Features of the fans and their application are discussed. Tables of performance data are included, which give electrical power requirements, delivery ratings at different static pressures, fan speeds, motor horsepowers, and other engineering data. Four pages. AMERICAN BLOWER CORPORATION.

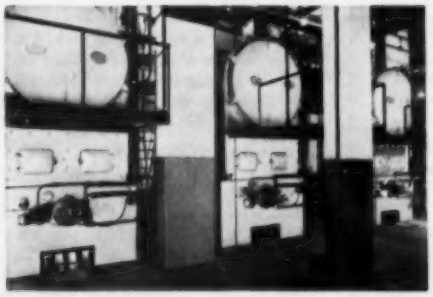
412-Two-stage boiler feed pumps

Close-coupled and frame-type two-stage pumps in capacities to 300 gpm at heads from 300 to 550 feet at 250 F are

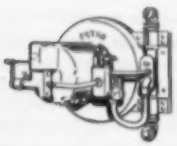
TISHMAN REALTY AND CONSTRUCTION COMPANY, INC. INSTALLED

20 PETRO OIL BURNERS

IN TEN BIG NEW YORK BUILDINGS



Sutton Terrace (shown at top) consists of three 12-story buildings accommodating 495 families. Heat is supplied by three Titusville boilers, each rated at 42,500 sq. ft. of radiation and each fired with a WD 8 AH Petro burner. This installation has three 15,000 gallon, 10 ft. diameter fuel storage tanks.



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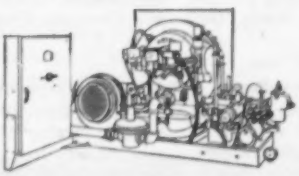

***"Petro oil burners give us the cleanliness, dependability, and economy of operation we require,"* says Alan Tishman**

Providing heat for 9 huge apartment developments and power for a 13-story manufacturing plant is a tremendous responsibility, but Tishman Realty and Construction Co. Inc., have found that they can rely on Petro oil burners to do the job. "The ability of our Petro oil burners to immediately respond to fluctuating heat and power demands without over-firing or under-firing is a vital factor in keeping our fuel costs low and our tenants happy," says Mr. Alan Tishman.

Oil automatically preheated for sure firing and lower fuel cost To insure quick positive starting and steady, uniform firing, Petro oil burners automatically *preheat* oil to an efficient temperature before it is injected into the firebox. This Petro method of preheating oil also enables users to burn the heavy fuel oils (Nos. 5 & 6), which average 8% richer in heat value, without complicated mechanical gadgets that cause service and adjustment problems. You save worry *and* money with Petro oil firing.

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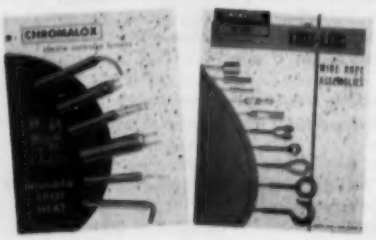
described in Bulletin 52B6105C. Pumps are suitable for boiler feed, humidifier, air conditioning, high head building, and mine service. Dimension tables for both types of pumps and performance charts are included. Six pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

414-More rapid heat transfer

New heat-transfer surface that consists of longitudinal fins inside a tube with outer fins is described in Bulletin 850. Inner-Fin provides greater surface area and smaller hydraulic radius so heat transfer is more rapid. Typical applications include refrigeration, air conditioning, and processing. Typical performance data are presented graphically. Four pages. BUSH MANUFACTURING COMPANY.

415-Handbook on specialty steels

Distinctive characteristics of a broad range of special purpose steels in terms of end use are given in this comprehensive handbook. It briefly summarizes tool and die steels, stainless steels, silicon and high-nickel electrical alloys, special purpose alloy steels, valve, heat-resisting and super-alloy steels, tubing and pipe, and fine wire. Will help to match the proper steel to the job. Thirty-two pages. THE CARPENTER STEEL COMPANY.



416-Electric cartridge heater

Electric cartridge heaters, or spot heaters are described in Bulletin 850. Illustrations show how an added spring stress release gives protection to lead wires against flexing stress and vibration. Specially designed conduit protects and seals cartridges against moisture or abrasion. Available in ranges from 30 to 2000 watts and sizes from ⅜-inch up to 1¼-inch diameter. Four pages. EDWIN L. WIEGAND COMPANY.

417-Wire-rope strength tables

Tables of wire-rope breaking strengths are included with descriptions of standard Tru-Loc fittings and assemblies in Catalog TL 500. Reference charts, tables, and drawings are included with a section on special assemblies that can be made to order. Twenty-four pages. AMERICAN CHAIN & CABLE CO., INC.

418-Heavy-duty condensate return

Condensation return units for heating systems with EDR ratings from 800 to 10,000, and pressures up to 80 psi are described in Bulletin 113-HR. Both simplex and duplex models (for returning condensate to two boilers or for connecting to a single boiler and providing a builtin standby pump) are described. Four pages. AURORA PUMP DIVISION, NEW YORK AIR BRAKE COMPANY.

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419-Wall chart for caustic safety

Handy wall chart that gives 37 specific suggestions for safe handling of solid, liquid, and flake caustic soda is based on accumulated plant experience. Printed in two colors on coated linen stock. Covers first aid measures, protective practices and equipment, dissolving and unloading procedures. There is space for emergency telephone numbers. DIAMOND ALKALI COMPANY.

420-Aluminum bronze alloy data

Chemical and physical properties of Ampco metal, an aluminum bronze alloy of the high-aluminum, high-iron type, are presented in Bulletin 33b. Each alloy is described with the aid of photomicrographs, and suggested uses are included. Twenty pages. AMPCO METAL, INC.

421-Pocket handbook on alloys, fluxes

Information for all engineers responsible for jointing, tinning, or cutting of steel, aluminum, and aluminum alloys, cast iron, copper, copper-bearing alloys, magnesium, nickel, monel, stainless steel, and zinc die-cast is now available in pocket-sized handbook. Data on 15 alloys not previously cataloged are included. Thirty-two pages. ALL-STATE WELDING ALLOYS CO., INC.

422-Activated carbon for air pollution

Various types of atmospheric contaminants, and ten types of treatment to eliminate or reduce them in industrial exhaust gases are described in Bulletin E-21. Use of Adsorbite activated carbon, either as the sole purification medium, or in combination with a present installation, is explained in detail. Four pages. BARNEBEY-CHENEY COMPANY.

423-Automatic combustion control

Balanced system of synchronized controllers, fully compensated for all variables, for maintaining constant steam pressure, correct fuel-air ratio, and a fixed predetermined furnace draft are described in Bulletin E-104. All controls are housed in dust-tight steel cases with hinged doors suitable for flush or surface mounting. Contacts are guaranteed to last indefinitely. Four pages. RELIANCE INSTRUMENT MANUFACTURING CORP.

424-Enclosed switch catalog

Electrical data and technical information on a wide variety of enclosed switches for use on ac or dc industrial applications are offered in Catalog 83. Photographs, dimensional drawings, and circuit diagrams for 90 different switches are included. Twenty-eight pages. MICRO SWITCH DIVISION, MINNEAPOLIS-HONEYWELL REGULATOR COMPANY.

425-Proximity-meter manual

Precision electronic instrument that measures without touching the specimen is described in Manual TM-951-1. Fifteen applications including concentricity gauging, automatic weighing, paint or insulation thickness gauging are included with instructions for hooking up the instrument. Twenty-eight pages. FIELDEN INSTRUMENT DIVISION, ROBERTSHAW-FULTON CONTROLS COMPANY.

426-Swing pipe-joints for high pressure

Swing joints that can be used for conveying steam, air, or liquids through moving pipelines, or to supply machinery or equipment while in motion are described in Bulletin 167. Cutaway views and dimensional data are included with well-illustrated typical industrial applications. Four pages. FLEXO SUPPLY COMPANY, INC.

427-High-temperature mechanical seal

Rotary mechanical seal that successfully handles hot oils or water at temperatures up to 800 F is explained in

"Used many makes of turbines... PREFERS COPPUS"

If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

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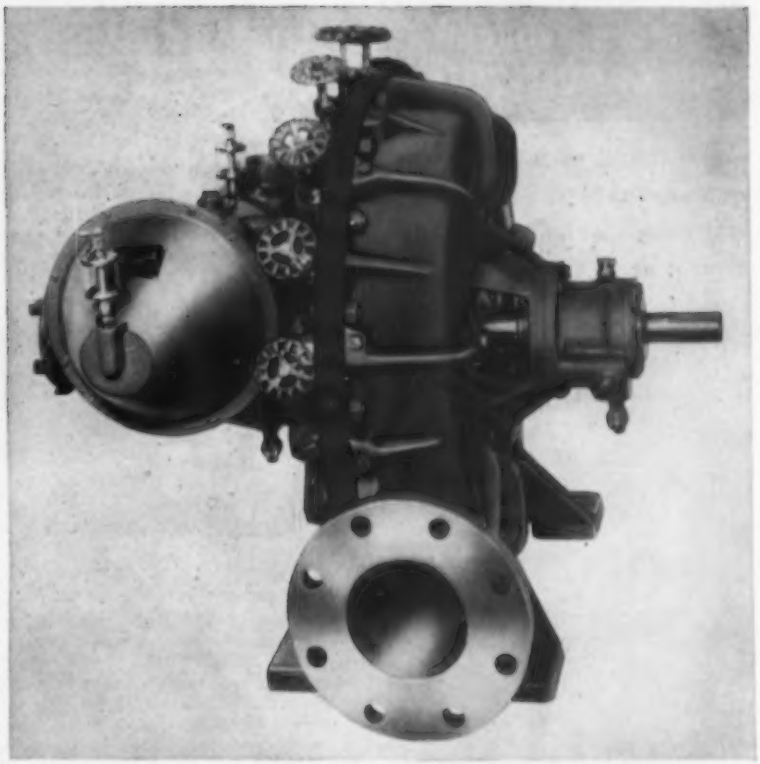

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new bulletins

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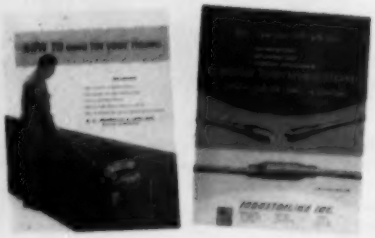
Bulletin 470. Two adaptations are available—balanced and unbalanced assemblies. Seal is simply constructed and easily installed on existing equipment. Four pages. DURAMETALLIC CORPORATION.



428-Maintenance program for floors

Long-range and day-to-day maintenance programs for all types of floors are described in Bulletin 3021. Also includes suggested treatment for some of the more common floor failures such as loose tiles, yellowing, lack of water resistance, blooming and tackiness. Twenty-four pages. S. C. JOHNSON & SON, INC.

429-Waterproof connections on site

How to make quick waterproof Neoprene-insulated heavy-duty cable connections on the job is told in Bulletin 131-5M. Technique uses a 110-volt portable molding kit to permanently seal metal connectors and electric cable in Neoprene sleeves. Only five steps and no experience are required. Four pages. INDUSTRILINE INC.

430-Quick high-flow coupling

Fully-detailed cutaway drawing of a quick-connected coupling that gives maximum flow with minimum pressure drop is shown in Bulletin 230. Uses and construction of the coupling are listed with complete dimensions of all parts. Four pages. SNAP-TITE, INC.

431-Pyrometer service tips

Useful service tips for pyrometer users are given in Bulletin F 7259. Reference material is an accumulation of information gained by the company's service organization. Twelve pages. BARBER-COLMAN COMPANY, WHEELCO INSTRUMENTS DIVISION.

432-Reference book on Foamglas

Physical properties of Foamglas cellular-glass insulation, and suggested thicknesses for temperatures between -50 and 800 F are offered in Bulletin 37-D-1, 2. Condensed recommended specifications and application photographs make this a worthwhile reference book for engineers. Eight pages. PITTSBURGH CORNING CORPORATION.

433-Refrigerant coolers and condensers

Detailed descriptions of dry-expansion Freon and storage coolers, condensers, and a patented slug eliminator balance loader are available in Bulletin 4001. Units available in a wide range of sizes, will fit any industrial cooling application. Five piping diagrams are included. Four pages. THE PATTERSON-KELLEY CO., INC.

434-Activated alumina drying agent

Detailed technical description, advantages, and an examination of typical applications of activated alumina are offered in Bulletin C4-5-755. Product is inert to most chemicals, absorbs moisture readily, yet can be efficiently reactivated by heating. Two pages. REYNOLDS METALS COMPANY.

435-Door heater selection chart

Chart for selecting the proper size heater for a given size door and given temperature conditions is available in Bulletin DH-2. Heater puts a curtain of high-velocity hot air between the outside cold air and indoor workers whenever the doors are opened. Dimensions, capacities, and methods of control are included. L. J. WING MFG. CO.

436-Magnetic-pulley selection method

Simple selection method for magnetic pulleys is presented in Bulletin 303-C. Includes detailed specifications on magnetic pulleys and pulley separators. Details of a two-coil pulley design which creates a more effective magnetic field is included. Sixteen pages. STEARNS MAGNETIC, INC.

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437-For leaks and water seepage

Leaks in basements, tunnels, reservoirs, dams, pits, elevator shafts, and mines can be sealed with a ¾-inch layer of Stontite. Leaflet MP 250/6-55 describes application techniques with the aid of photographs. STONHARD COMPANY.

438-Hot-water boiler safety controls

Safety valves, low-water fuel cutoffs, and feeder cutoff combinations are described with engineering data in Bulletin P-30. Common questions about hot-water boiler safety are answered with the aid of colored diagrams. Eight pages. McDONNELL & MILLER, INC.

(more new bulletins on page 28)

Testing Noise Levels

SORGEL transformers are known and chosen for their quiet operation, because their noise level is well below the established standards.

Because of their quiet operation, SORGEL transformers are particularly adaptable for indoor installations —in hospitals, schools, institutions, libraries, office buildings, stores, and other structures where low noise levels are an important factor.

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Hydro-Flex offers these outstanding features and more:

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- rugged construction features assure long trouble-free service.

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BOTTOM INLET SERIES
Hydro-flex traps with bottom inlet have the same high qualities and features as horizontal types.

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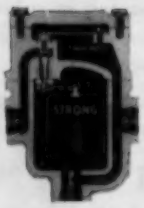
3 types available for wide range application . . . to meet pressure and capacity requirements.



BLAST TRAPS
Thermal types for quick air and condensate removal during rapid heating up.

STRONG STRAINERS
Offer maximum protection from dirt, scale or sediment. Available in semi steel, cast steel and bronze.

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439-Protective coating coverage table

Coverage table is offered with this bulletin on Tapecoat-X which safeguards pipe, pipe joints, fittings, and couplings at lower cost. Tape offers double-wrap protection with single-wrap application. Four pages. TAPECOAT COMPANY.

440-Boiler instrumentation data

Modern power plant instruments and control systems are described with the aid of photographs and schematic drawings in Bulletin 55-605-83. Combustion instruments and panels are treated in detail. Twenty-four pages. THE HAYS CORPORATION.

441-Texrope-drive selection tables

Handy multicolor tables for quick and easy selection of constant speed Texrope V-belt drives is now available. Booklet 20P40 also contains information on design features, basic drive principles and data on sheaves. Seventy-four pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

442-Boilers with U.L. approval

Several series of "steamboiler-plants" have received Underwriters' Laboratories, Inc. approval. Listing applies to gas-fired, oil-fired, and gas-oil-fired boilers in ranges from 12 through 60 hp with operating pressures from 15 to 200 psi. Bulletin A-104 contains size and rating information with engineering data. Boilers can be insulated at the factory if required. ECLIPSE FUEL ENGINEERING CO.

443-Rubber hose for every use

Specifications and descriptions of 68 different rubber hoses for every industrial use are offered in Catalog Digest 3765-R. Also contains data on nine types of conveyor belts, seven types of flat power transmission belting, V-belts, chute lining, and rubber sheet packing. Cutaway drawings show construction. Eight pages. INDUSTRIAL RUBBER DIVISION, THERMOID COMPANY.

444-Valves for corrosive service

Valves that successfully handle corrosive fluids in oil refineries and industrial plants producing caustics, textiles, rayons, fertilizers, coke, and paper are described in Bulletin 592. Valves are available in bolted bonnet or "king-clip" patterns, with screwed or flanged ends and in sizes ranging from ½ to 8 inches. Available in both 316 stainless steel or monel metal trim. LUNKENHEIMER CO.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 81.

445-Expansion joint selection guide

This data book is a must for any engineer interested in expansion joints. Catalog 135 contains piping layouts, installation instructions, and specifications. Also includes angular and lateral motion charts and 19 engineering tables. Twenty-six pages. FLEXONICS CORPORATION.

446-Versatile control valve

Valve which converts from pressure reducing and regulating back-pressure control by a simple switch of control lines is described in Bulletin 966. Recommended for air, water, light oils, gases, refrigerants, and noncorrosive fluids. Materials available, pressure and temperature ratings, engineering details, capacity, performance and construction features are listed. Four pages. A. W. CASH COMPANY.

447-Unit pump selection tables

Tables to help in the selection of unit pumps for every industrial application are given in Bulletin ET-452. All units feature leakproof mechanical seals and barrel-type pump brackets. Fourteen pages. BELL AND GOSSETT COMPANY.

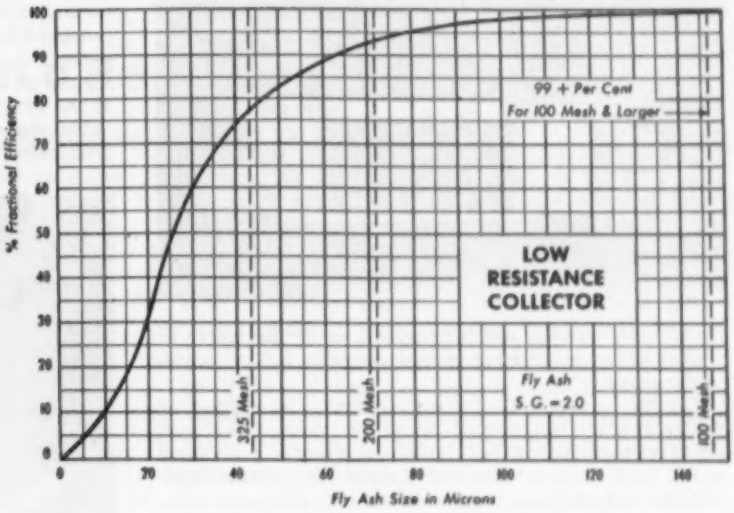
448-Data on new nickel alloys

Ductile Ni-Resist iron, a new engineering material that combines the strength and ductility of ductile cast iron with the corrosion and heat resistance of conventional Ni-Resist metal is described in Pamphlet 3114-DI-27. Summarizes present and potential industrial applications. Four pages. THE INTERNATIONAL NICKEL COMPANY, INC.

(more free bulletins on page 88)

New Buell "LR" Fly Ash Collector... Top Efficiency on a Natural Draft!

Here's the ideal dust collector for boilers from 100 to 2000 BHP! Designed for extraordinarily low draft resistance, the "LR" Collector has proved effective on *natural*, as well as *forced* draft installations. Delivers top efficiency in collecting all kinds of cinder discharge, 100-mesh and larger!



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ideas in action

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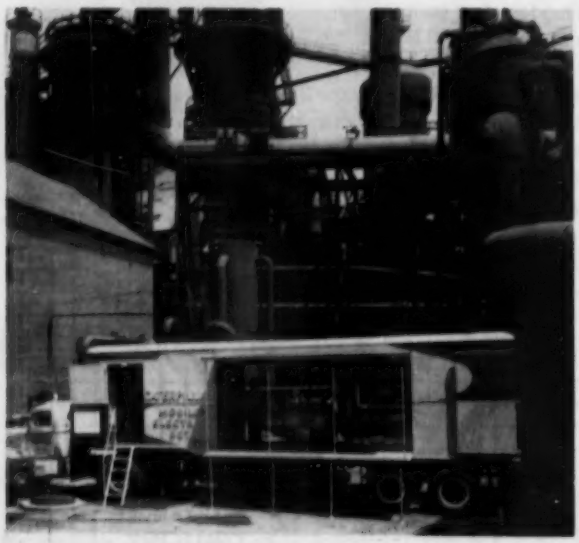
Portable power unit keeps coolant flowing

While utility servicemen altered electric circuits, emergency power for protection of vital equipment at Crucible Steel Company of America's Midland, Pa. mill was supplied recently by a Caterpillar diesel-electric set driven to Midland from Peoria, Illinois. Power interruption at Midland demanded auxiliary power equipment to operate water cooling pumps and to prevent blast fur-



naces from burning out. Complete loss of the water as cooling agent could have caused up to $1 million worth of damage.

The 500-hp diesel-electric set is mounted on a van-type trailer. It is the largest road-borne emergency power unit yet developed. Technicians started the emergency set when utility lines were disconnected. Special control switchgear is mounted in a compact panel in the van. One man operates this mobile emergency plant. It can be hooked up and supply power within 15 minutes after its arrival. Unit supplied necessary electric power for 48-hour's continuous operation of Crucible Steel's water pumps. Engine burns 25 gallons an hour of ordinary furnace oil at a maximum load of 315 kw.

Hydraulic fluid finds boiler setting leaks

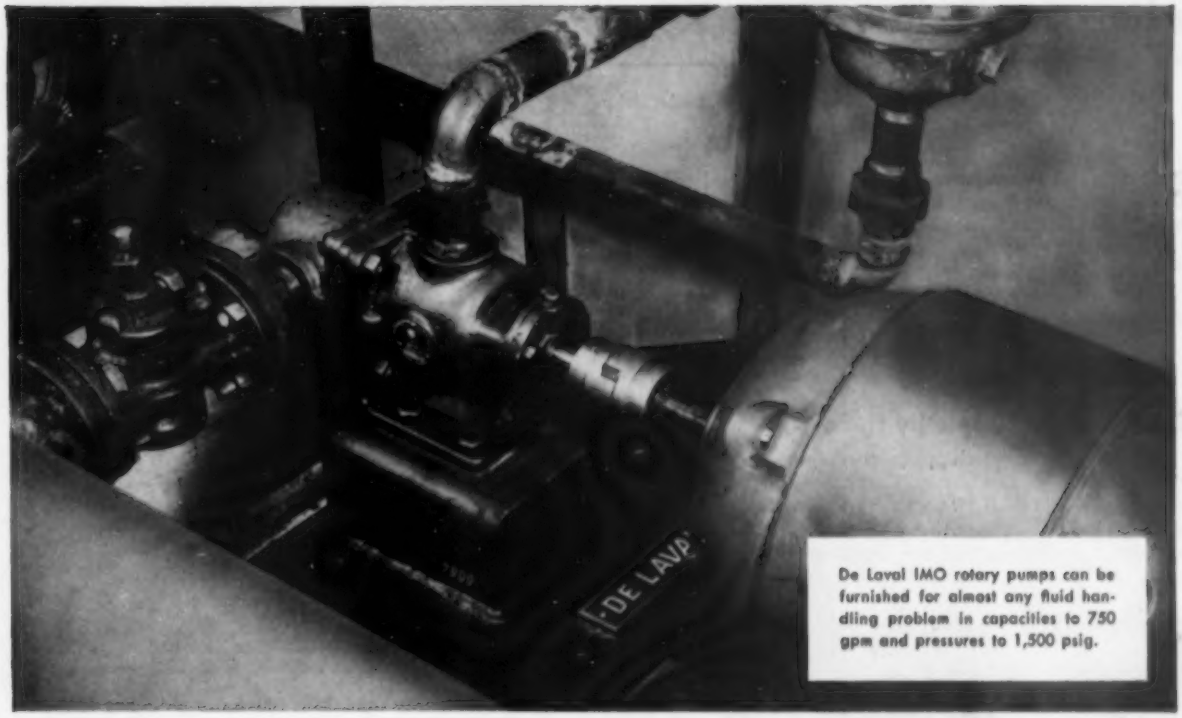
New method of detecting air leaks in boiler furnaces uses a controlled fire-resistant hydraulic-fluid fog. Method is being used by Consolidated Edison Company of New York, who estimate savings of $100,000 yearly in fuel and maintenance costs. Pydraul F-9, manufactured by Monsanto Chemical Company, is introduced into the furnace by means of a Todd Industrial Fog Applicator to produce a steady flow of visible fog from every leak. When furnace is thoroughly sealed, forced draft is applied to build up a furnace pressure of 0.3 to 0.5 inches of water. Fogging machine then breaks down the hydraulic fluid into tiny flotation droplets which enter the furnace by a hose through an access door or other opening.

For pressurized boilers, the hose connection is made to a 4½-inch gate valve. Fog is generated until all leaks are observed and marked on exterior walls. Minimum boiler downtime is required since fog is neither plentiful nor obnoxious enough to hamper leak detection. Method can also be used to detect leakage in turbines and condensers when the turbines can be sealed at the shaft. Pydraul F-9 fire-resistant hydraulic fluid is the first of its type to receive Underwriters' Laboratories, Inc. approval.

Military mechanizes copying and control of drawings

New techniques for mechanized reproduction and filing, finding, and control of engineering drawings are being practiced by several branches of the government. Dollar savings in one military-service branch alone have been figured at over $10,000,000 annually. Methods specialists at one processing center made a check on costs of getting out a single drawing, reproducing it, delivering the reproduction, and refiling the materials after use. It came to

$15. Engineering drawings will be microfilmed and mounted on Filmsort aperture cards — punched, or visible indexing type. Reproducible drawings—on 35 mm film and aperture card mounted—will be provided to military bases and other groups using engineering drawings. Photo-copying units and supplies for fast, inexpensive reproduction will be set up in many parts of the country as required. Equipment for punching, collating, and control of drawings, specifications, and related material is be-



De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONCON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

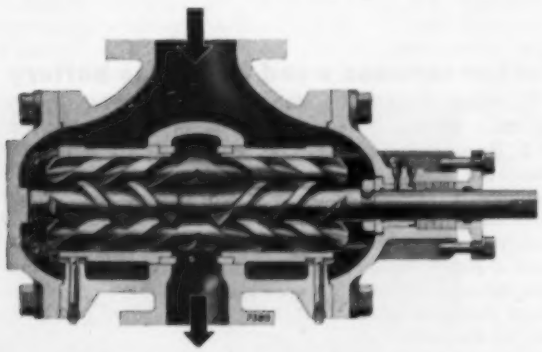
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

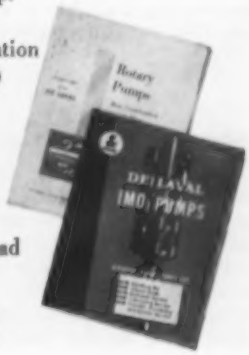
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application,* contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 857 Nottingham Way, Trenton 2, New Jersey. DL-301



Circle 139 on READ-N-CIRCLE card for more data

ideas in action

. . . starts on page 30

ing set up where necessary for fully mechanized handling. One government branch handles as many as 100,000 drawings a month in their own engineering development activities and in processing copies from suppliers' original drawings. From these, as many as several hundred blueprints or copies may be required. Another advantage of the mechanized system is in savings on transport.

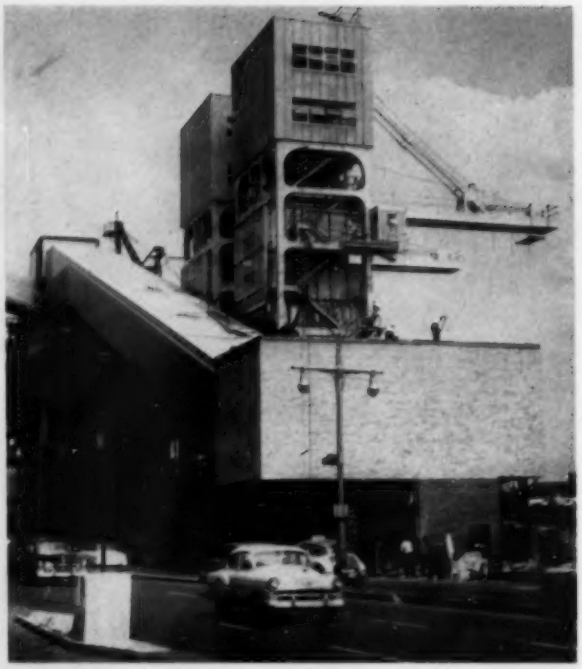
Transformers come by the drum

Reusable, all-steel shipping drums are being used for Pennsylvania Transformer Company's new gasketless boltless Perfect Seal "Pole Star" distribution transformers. Fireproof, cover-gasketed, metal containers provide maximum protection for the transformer—both in shipment and during storage. Handling and stacking is also

simplified. Container may be reused. It eliminates disposal problem and resultant fire hazard common to ordinary shipping crates. Transformer is held firmly in place within the container by a blocking arrangement between the drum cover and the center lifting ring. Transformers are available in no-tap sizes from 3 through 25 kva, 2400 through 14,400 volts.

Subway coal gets elevated

Two new towers for unloading coal barges are being constructed by the Mead-Morrison Division of McKiernan-Terry Corporation as part of the New York Transit Authority's East 74th Street power plant. Plant, now undergoing an extensive modernization program, supplies power to New York City's expanding subway system. A runway parallel to the East River will allow 300 feet of travel to the towers. Two 2000-ton barges will be able to



unload at the same time. The 400-ton towers are of rigid-frame riveted construction, and are designed so that two conveyor belts can be fed by either tower. With an average cycle rate of 35½ seconds, each tower has a free-digging rate of 450 long tons of slack coal per hour. The buckets weigh 11,000 pounds and hold five tons of coal each.

Solar power's progress demonstrated

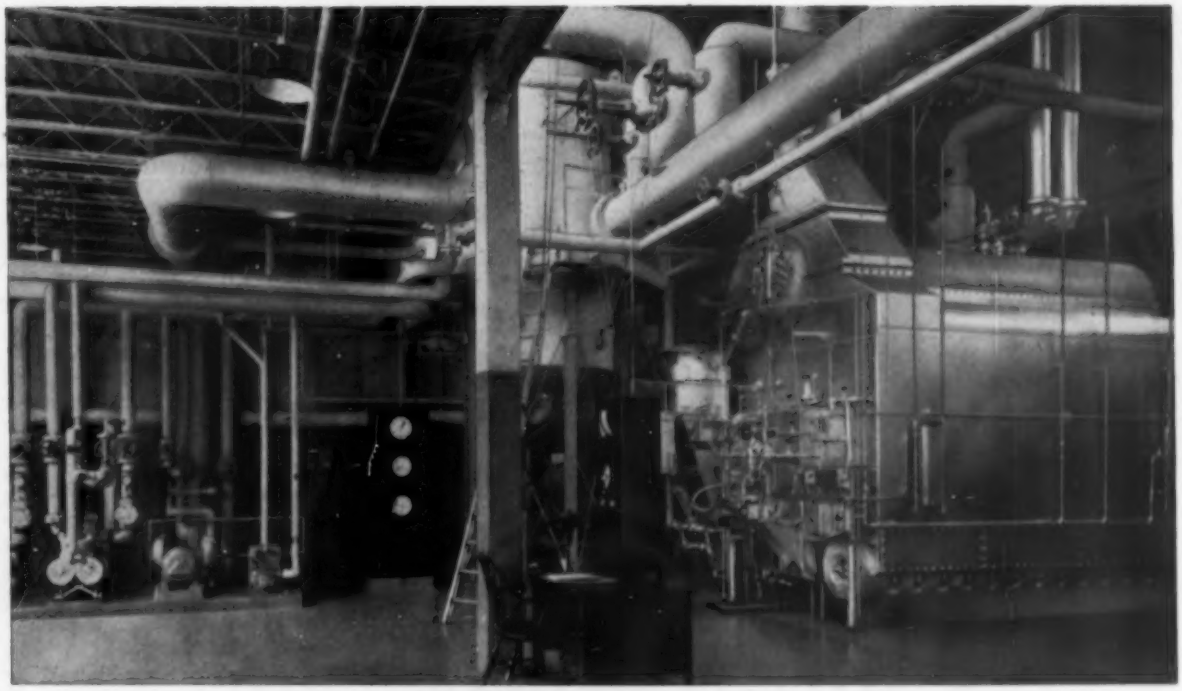
Solar power is operating electric motors and two oscillators at the Wescon Show in San Francisco. Hoffman Electronics Corporation is demonstrating the solar-powered units, which are driven by silicon batteries manufactured by its newest division, National Fabricated Products. Solar battery is a thin, blackish wafer about the size of a half dollar. It has two terminals. When exposed to light, it will generate about half a volt. Each wafer is made of highly purified and specially treated silicon. Three wafers generate sufficient power to operate the motor or oscillator display. A square yard of the batteries would run an electric fan. A few acres would power a fair-sized town.

Rubber replaces wood for bridge battery

Canadian National Railroad engineers recently replaced a 44-year-old stationary battery at Black Rock, N. Y. It was installed in a swing bridge over the Erie Canal when the bridge was built. Battery supplies power for peak loads that occur when the bridge starts to move. Two 100-hp motors rotate the bridge, which weighs 5000 tons. It opens and closes about 2600 times per year. Power from a public utility recharges the batteries at constant rate through a motor-generator set, so that the peak-demand charge is lower than if the set furnished power direct to the motors.

Old battery consisted of 256 cells made up of lead-lined wooden boxes in which the plates were suspended. It was

(more ideas in action on page 36)



Union packaged boilers exceed 80% in efficiency tests at University of Toledo

Job Report (UIW)—Not only do two Union Type MH Packaged Steam Generators provide space heat for 14 buildings on the University of Toledo's 170-acre campus, but they also take part in the educational process. Utilized for laboratory work by mechanical engineering students, these Union Steam Generators are reported to operate at "better than 80% efficiency."

Says University of Toledo, "We get 128 lbs. of steam per gallon of fuel oil as compared to 93 lbs. per gallon with the old boilers formerly used. The new plant, in operation since the fall of 1953, uses #6 oil in the winter and #5 in spring and fall. During the past year, 361,746 gallons were used, producing 46,180,000 lbs. of steam."

Users who have kept tabs on Union Packaged Boilers as carefully as University of Toledo, report like economies. From coast to coast, Union Type MH Steam Generators have proved their worth in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals, to name a few.

Completely shop-assembled in Erie, Pa. for delivery via rail or truck, Union Type MH Units are patterned after larger but similar field-erected Type H Boilers, originated by Union over 16 years ago. They can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering.

For example: Superheaters can be installed to meet total temperature requirements, while air heaters and economizers are readily supplied when needed.

Standard units are designed in 13 sizes from 10,000 to 40,000 lbs. of steam per hour at 250 psi, with higher pressures available for special applications.

The complete story on Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.

AT TOP: 28,000 lbs. of steam per hour—that's the capacity of this Union Type MH Packaged Steam Generator which operates at 125 psig with 180 degrees feed water temperature (one of a pair serving University of Toledo).

LEFT: Steam generating plant houses two Union Packaged Steam Generators to provide space heat for 6,000 students.

RIGHT: Cut-away view of Union Packaged Boiler reveals its symmetrical, 3-drum design; divided tube banks and tangent tube wall construction.

Circle 107 on READ-N-CIRCLE card for more data

our readers write

. . . to industry & power

Thermo refresher going strong

Gentlemen:

In a recent issue of INDUSTRY & POWER, namely June 1955, on page 63, it was my pleasure to read an article "A Thermodynamics Refresher, II" in which I became quite interested.

I am now quite anxious to read article III. Unfortunately, I missed part I, and would like very much to get a copy to complete the series. Also please advise whether or not reprints of parts II and III are available.

Also please advise if reprints of the article "Steam Power Cycle Relationships—III" are available.

M. A. Flemming
Plant Manager
The Polymer Corporation
Reading, Pa.

• *Additional copies of all articles in the Thermodynamics Refresher Series have been printed. Requests such as these are being filled promptly by our Reader Service Department.*

Canons are available

Gentlemen:

An article titled "What Ethics?" by Charles T. Chave appears on page 64 of the August 1955 issue of INDUSTRY & POWER. The article mentions the Canons of Ethics for Engineers, developed by the Engineers Council for Professional Development but does not state where we can get a copy. Can you help us?

D. W. Ross
Engineer
Engineering Department
Harper-Wyman Company
Chicago, Illinois

• *A copy of the Canons of Ethics for Engineers can be obtained from the Engineers Council for Professional Development, 33 West 39th Street, New York 18, New York. Copies of The Canon can also be obtained from most any of the 80 engineering societies that have endorsed them.*

Happy to oblige

Gentlemen:

May we have a duplicate copy of the July 1955 issue of INDUSTRY & POWER? The articles on pages 35 and 50 hold special interest for one of our company's departments.

R. S. Glicksman
Hydrocarbon Research, Inc.
New York, New York

• *We are always happy to oblige such requests as long as our supplies of back issues will permit.*

Vibration tamers named

Gentlemen:

In the August 1955 issue of INDUSTRY & POWER the subject article ("Vibration is Tamed So Simply") was read with great interest. I have a similar

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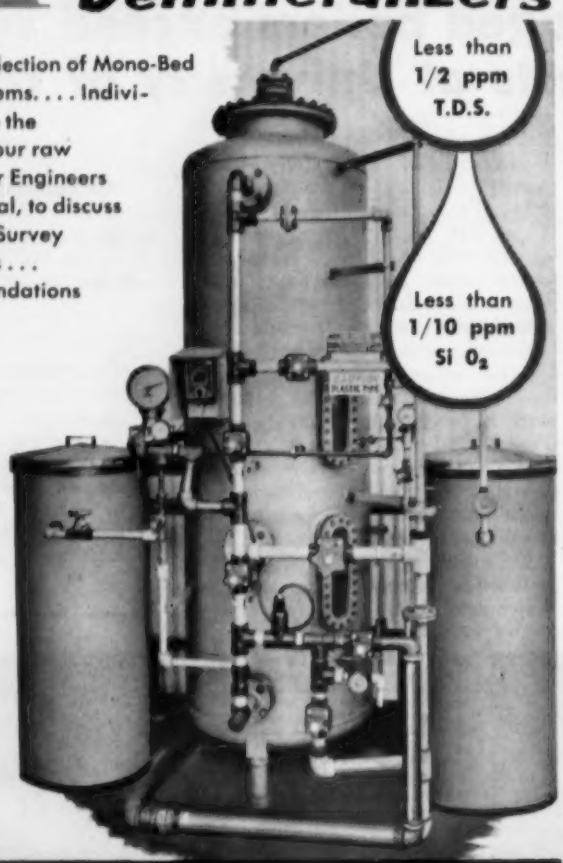
Industry's finest selection of Mono-Bed and Two-Bed Systems. . . . Individually designed to the requirements of your raw water supply. Our Engineers are at your disposal, to discuss your problem . . . Survey your requirements . . . Prepare recommendations and estimates.



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problem in our power house and want to know more of the details of the snubbers used by Mr. J. N. Straky, plant engineer, DeSoto Division, Chrysler Corporation. Will you send me information so that I can get details on these snubbers—this I would appreciate very much.

V. P. Allbert
Foreman
Goodyear Tire & Rubber Company of Kansas, Inc.
Topeka, Kansas

• *Complete information on the snubbers can be obtained from the manufacturer: Burgess-Manning Company, 741 Park Avenue, Libertyville, Illinois.*

Crossing information

Gentlemen:

In your July 1955 issue of INDUSTRY & POWER your article on "Crossing Requires No Maintenance" on page 26 is of great interest to me. I would appreciate obtaining more information on this article if it is available.

N. P. Cox
General Superintendent
Mechanical Shops
Armstrong Cork Company
Lancaster, Pa.

• *Complete information can be obtained from Blaw-Knox Company, Farmers Bank Building, Pittsburgh, Pennsylvania.*

Permanent insulation available

Gentlemen:

An article appeared in your April issue titled "Permanent Tank Insulation Costs Less," and I am very much interested in obtaining more information about the insulation itself and further data on how the K Factors were obtained for use in calculating the cost comparison.

Harold J. Lavori
Engineer
Boston Edison Company
Boston, Mass.

Gentlemen:

We are interested in obtaining name of the contractor who furnished and installed the insulation described in article "Permanent Tank Insulation Costs Less" on page 49 of April 1955 issue of INDUSTRY & POWER. May we hear from you soon in this respect.

A. W. Schroeder
Central Foundry Division
Saginaw Malleable Iron Plant
General Motors Corporation
Saginaw, Michigan

• *Complete information about the permanent tank insulation described in our April issue can be obtained from Tank Insulators, Inc., 426 East 110th Street, New York 29, New York.*

You can avoid motor burnouts

THE temperature surrounding motor protection equipment is an important factor in motor burnouts. In order to prevent nuisance stoppages in hot weather, the rating of protective equipment is often raised. Then, when plant temperature drops, protection is inadequate . . . motors are more subject to burnout.

This explains why an ever-increasing number of plants are standardizing on HEINEMANN Circuit Breakers as manual motor controllers. Set tripping points of HEINEMANN Circuit Breakers *are completely independent of ambient temperature.*

Moreover, HEINEMANN Circuit Breakers provide inverse time delay to permit starting inrush or harmless, temporary overloads . . . yet they provide the fastest circuit interruption available on large overloads, stalled rotors, single-phasing or short circuits.

HEINEMANN Circuit Breakers operate on a hydraulic-magnetic principle. They do not employ thermal elements or heaters. They are available with precise ratings to the motor, and are provided with time delay characteristics especially suited to trouble-free motor protection.

don't use heat ...USE POWER

Send for Bulletin 1410.

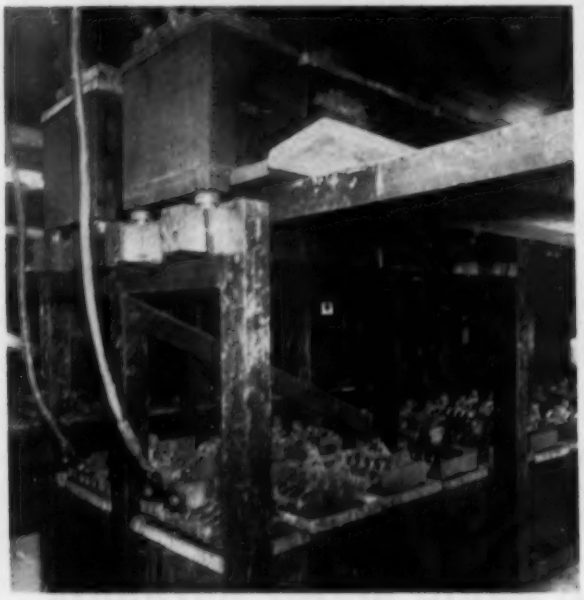
HEINEMANN ELECTRIC CO.

140 PLUM STREET • TRENTON 2, NEW JERSEY

Circle 110 on READ-N-CIRCLE card for more data

ideas in action

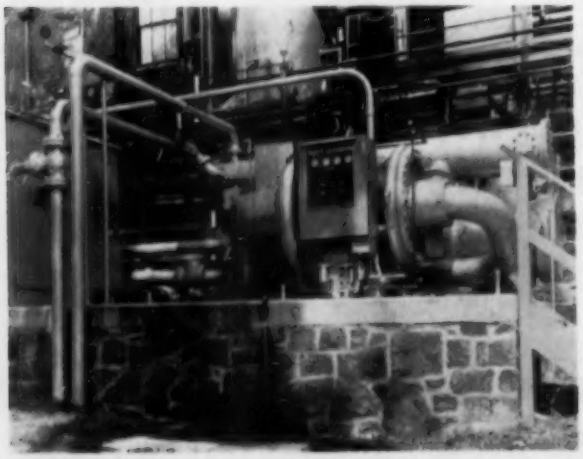
. . . starts on page 30



made by Gould-National Batteries, Inc. The cells were open to the air and gas evolved during charging escaped into the battery room. The new battery consists of 256 Gould Type EW-15 cells in rubber jars, full enclosed. New cells are more compact, and are at a convenient height for maintenance. Battery can supply sufficient power to open and close the bridge should the external power source fail.

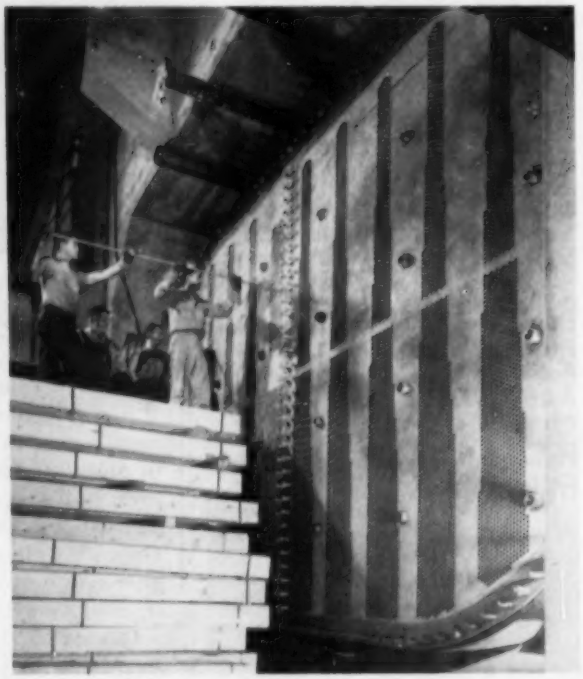
Water chillers move outdoors, save space indoors

Centrifugal water chillers are now being installed outdoors without protective enclosures. Trane Company has developed this version of its CenTraVac line for use in large buildings and industrial plants where space is at a premium. Hermetic construction and automatic operation make the chillers ideally suitable for outdoor use. The purge unit, control panel, conduit boxes, and capacity control mechanism are weather-proofed and heated electrically to prevent condensation. Insulation is waterproofed, and suitable weather-resistant paint is used on the exterior. All sizes (from 50- to 800-tons refrigeration capacity) are available.



Large surface condenser uses aluminum tubes

Oak Creek power station of the Wisconsin Electric Power Company will soon get a new 105,000-square-foot Allis-Chalmers surface condenser. It is believed to be the first unit of its size to be fitted with aluminum heat exchanger tubes. Use of aluminum was considered feasible after several years of testing in collaboration with Allis-Chalmers engineers.



Cheaper power by combining efforts

Two companies in need of more power now obtain it at less cost as a result of combining their generating efforts. Upper Peninsula Power Company, an independent utility, and The Cliffs Power & Light Company, a subsidiary of The Cleveland-Cliffs Iron Company, both needed greater generating capacity. Both started construction programs in 1952. UPPC proposed to install a 7500-kw turbogenerating unit with associated facilities at Houghton, Michigan. CPLC proposed to install 11,500 kw of capacity as an extension of their station at Ishpeming. Both companies, working with Stone & Webster Engineering Corporation, soon realized the advantages of intercon-

(more ideas in action on page 74)

you can still get
copies of I&P's special report on

in-plant electrical distribution

New trends are constantly reshaping electrical practice in industrial plants. This comprehensive report distills the essence of the trends reported exclusively to INDUSTRY & POWER by the country's leading manufacturers, designers, and users of industrial electrical distribution systems.

To meet the continuing demand for this special report, INDUSTRY & POWER makes reprints available to all readers. Single copies are free; 2 to 25 copies are 25¢ each; 26 to 50 copies are 20¢ each; 51 to 100 copies are 15¢ each; more than 100 copies are 10¢ each. Write, on your company letterhead please, to Reader Service Dept., INDUSTRY & POWER, Commercial Bank Building, St. Joseph, Michigan.

next month in
INDUSTRY & POWER . . . .

when nuclear power comes . . .

Nuclear power stations are already under construction for utilities. Last month, INDUSTRY & POWER (page 43) carried the prediction that nuclear power in industrial-size packages may be available by 1958. Auxiliaries will be a big part of your problems when nuclear power arrives. For a down-to-earth appraisal of what those problems may look like

watch for the November issue

INDUSTRY & POWER

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Quick-Operating EVERLASTING Straight-Through Valve

The standard Everlasting design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use.

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Shock-Resisting EVERLASTING Angle Valve

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EV 555

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names make news

. . . personalities from industry & power

Brown Fintube Co. has appointed **J. B. Carpenter** as sales manager of its Packaged Boiler division. He was formerly field engineer, and later export sales manager for the V. D. Anderson Co.

Johnston

Schreiner

Sterling Electric Motors, Inc. has appointed **Edgar K. Johnston** as vice president of manufacturing and **John R. Eastman** as chief engineer. Johnston was previously factory manager and Eastman has served as chief electrical engineer.

Elliott Company has appointed **Captain Max Schreiner** (USN retired) as executive engineer. He will be responsible for all engineering of the company's turbine, compressor, supercharger, and general apparatus divisions. He was formerly commanding officer and director of the US Naval Boiler and Turbine Laboratory, Philadelphia.

The Airetool Mfg. Co. has appointed **Paul W. Martin**, member of the Research and Development department, to direct the company's research activities in the development of new products and the improvement of its established products.

Hammel-Dahl Co. has elected **John R. Curran** to the position of vice president. He was formerly chief design engineer and director of engineering.

Smooth-on Mfg. Co. has selected **George T. Morse** as vice president and director of sales. He is a graduate ceramic engineer of Rutgers University, past president of the Ceramic Association of New Jersey, and a Fellow of the American Ceramic Society.

Allis-Chalmers Manufacturing Company personnel changes include appointment of **Hugh L. Ross** as assistant manager, and **Charles L. Babb** as chief engineer of the centrifugal pump department. **J. V. McGuire**, sales manager, switchgear department, has been promoted to department manager. **Robert S. Fleshiem**, assistant to the vice president in charge of industries group, has retired after more than 50 years' service. He was a member of the board of governors of the NEMA and was awarded a 50-year certificate by that group.

Michigan Tool Company has promoted **N. P. Synnestvedt** to plant manager of its Manistee Iron Works division, and **J. G. Maurer** as shop superintendent.

American Air Filter Company, Inc. has announced that **Dwight M. McMakin**, assistant manager of its engine and compressor department, has been appointed as an Associate of the Executive Committee of the Oil and Gas Power division of the ASME.

National Electric Products Corporation has appointed **Kenneth C. Crain, Jr.** as superintendent of its Ambridge, Pa. wire and cable mill. He was formerly assistant plant superintendent for the E. L. Wiegand Company.

Babcock & Wilcox Company has announced the retirement of **A. M. Kohler**, vice president and head of its Refractories division after 42 year's service. He was appointed general manager of the division in 1930, and elected vice president in 1947. **J. E. Brinckerhoff**, manager of the division, will assume Kohler's duties.

Gebhart

Kominek

Rockwell Manufacturing Company has named **H. C. Gebhart** as chief engineer of its Delta Power Tool division. He succeeds **John B. Unterweger**, who was promoted to factory manager.

Infilco Inc., has promoted **Edward G. Kominek** to the position of general sales manager. He will be in charge of all sales representatives in the United States, Canada, Mexico, and company offices in other foreign countries.

Clark Controller Company has named **David C. Wycoff** as manager of its Product Adaptation department. Wycoff was formerly manager of the company's experimental laboratory.

Themiszer

Larson

Cook Electric Company has appointed **Hubert J. Themiszer** as manager of its Magnilastic division. He was formerly project engineer of the research laboratory. **Earl Washburn** becomes manager of Electronic Systems division.

Oxy-Catalyst, Inc. has appointed **Gordon P. Larson** to the position of vice president. Larson was formerly director of the Los Angeles Air Pollution Control District. He is a graduate of the U. S. Military Academy at West Point.

Worthington Corporation announces several promotions. **William C. Osborne** becomes assistant to the manager of engineering. **Norman L. Meyerson** is promoted to manager, research and development division. **Charles A. Macaluso** becomes assistant manager, research and development division.

The Louis Allis Company announces the election of **E. P. Allis** as Chairman of the Board. **John W. Allis** was promoted from vice president to president.

Ralph M. Hardgrove of the Research division is to receive the Percy Nicholls Award for his outstanding contributions to the science and technology of solid fuels. Hardgrove has been issued 79 patents in the field of combustion and steam generation.

Westinghouse Electric Corporation has elected new officers. **Gwilym A. Price** was elected president and chairman of the board. The board chairmanship has been unoccupied since 1951. **Mark W. Cresap, Jr.** was elected to serve as executive vice president and deputy

chief executive officer. **Latham E. Osborne** was elected vice chairman of the board. **John K. Hodnette** was elected vice president-general manager, and member of the board. **A. C. Monteith** was appointed to succeed Hodnette, and **Dr. John A. Hutcheson** will assume Monteith's duties.

General Electric Company has selected **Henry E. Heddesheimer** as consultant on electrical engineering in its Plant Engineering and Maintenance services. He is a registered Professional Engineer in the state of Georgia and a member of the National Society of Professional Engineers.

Crouse-Hinds Company has named **John R. Tuttle** as president and chairman of the board of directors. **William L. Hinds,** present chairman of the board, **Albert F. Hills,** president, and **W. C. Blanding,** executive vice president, will retire from active management. These three men, representing a combined total of 158 years of company service, will continue as members of the board of directors.

B. F. Goodrich Chemical Company has appointed **Thomas B. Nantz** as general manager of its plants. **Walter E. Brodine** will succeed Nantz as plant manager at Calvert City.

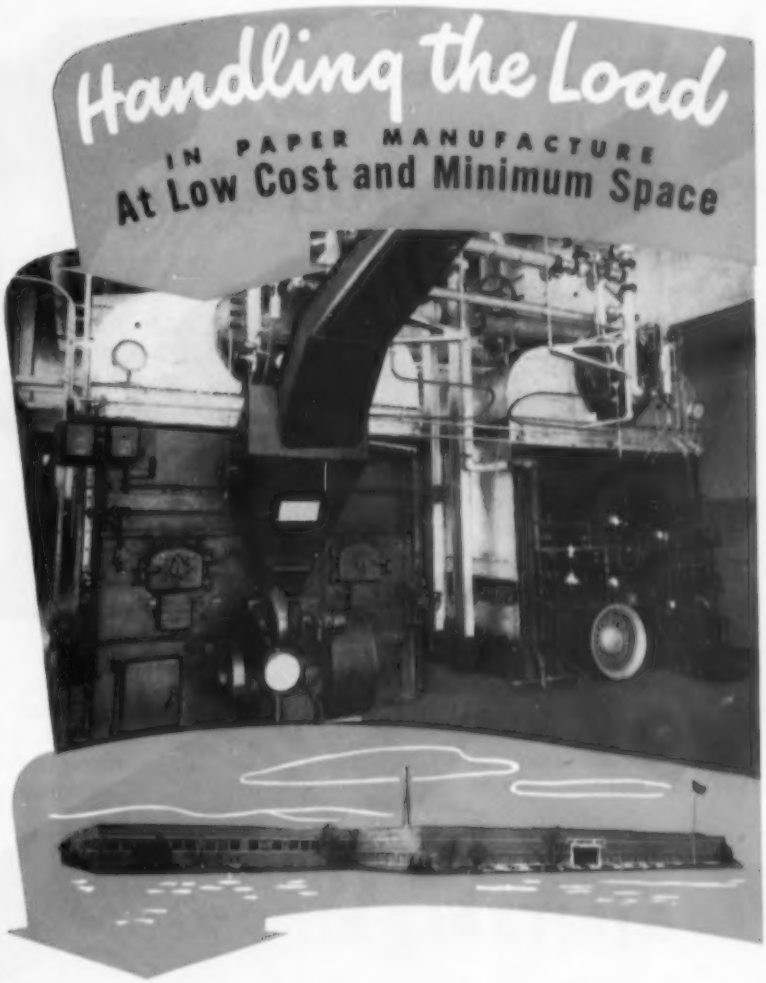
Robertshaw-Fulton Controls Company announces the election of **R. S. Reynolds, Jr.** as chairman of the board. He succeeds his father **R. S. Reynolds, Sr.** who died July 29. **J. Louis Reynolds** and **John A. Robertshaw, Jr.** were named to fill vacancies on the board.

Ross

Larson

National-U.S. Radiator Corporation has announced the association of **Dr. Walter L. Ross,** formerly assistant professor of mechanical engineering at Pennsylvania State University, with its engineering and research department. He will be manager of the company's development laboratories.

Minnesota and Ontario Paper Company announces the appointment of **Clarence Larson** to the position of vice president in charge of operations. **E. L. Lamb** is promoted to director of manufacturing. **J. H. Davidson** will head the newly-created Central Engineering division.



TITUSVILLE TICOTHERM
STEAM GENERATORS

For Paper Manufacturers Company, at their Bustleton, Pa. plant, two main types of firing are handled efficiently by these Titusville TICOTHERM Steam Generators. No. 1 boiler has a ram-type underfeed stoker, No. 2 is equipped with oil burner for standby, providing flexibility for all processing and heating needs of the large plant pictured.

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Circle 106 on READ-N-CIRCLE card for more data

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- **Good for all pressures without change of valve or seat.**
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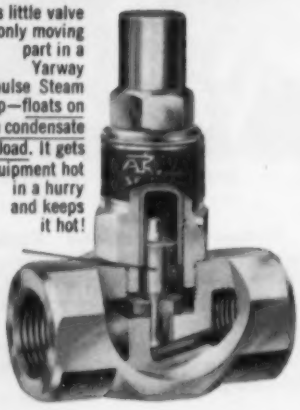
- **Six standard sizes, ½" to 2".**

Want proof of performance? Try a YARWAY Impulse Trap and Fine Screen Strainer FREE for 90 days in your own plant. For free trial or free catalog, write . . .

YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.



This little valve —only moving part in a Yarway Impulse Steam Trap—floats on the condensate load. It gets equipment hot in a hurry and keeps it hot!

YARWAY impulse steam trap

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Civil Defense needs power services

Gov. Val Peterson
Administrator
Federal Civil Defense Administration
(as told to Harold A. Bergen, Editor)

IN SPITE OF the splendid job our military is doing, a resolute enemy could put enough bombs over our cities to bring terrible destruction. If an enemy comes, we'll make him pay a tremendous price, but he'll accomplish his mission. I know of no one in a responsible position in government who will deny that.

Now, our society is so dependent on power that we cannot operate in either peacetime or wartime without available power. I feel it is incumbent on all producers of power to see that we do have the greatest possible supply under any and all circumstances.

Power is absolutely essential to Civil Defense Readiness. There will be the highest premium placed on power people in time of emergency. We'll have to tie all available power together. We'll have to utilize every power-producing facility there is. We'll need every kw we can get. In government, we are planning right now for steps to insure power supply.

Some scattered industries are doing a good job of preparing for nuclear war. Many have done little or nothing. What good work there is is spotty. If America is to survive, Industry along with the rest of the country, has to get busy. There must be a willingness to recognize the threat before us and a further willingness to face up to it — that is, to face up to the capability of an enemy. I have full confidence that Americans will take the proper steps when they know what that threat is. Government's job is to make that threat clear. Leaders in Industry have the capability to take the ball from there.

But, we have been slow to act in Civil Defense so far. There are several reasons for this. First, Americans are hoping and praying that there won't be a war. (I join them. War is archaic in terms of today's weapons.) Second, some are *wishing* there won't be war. This leads to a psychological block against preparation for Civil Defense. It leads people to refuse to exercise prudence.

Third, some people say that nuclear war is so horrible that there is nothing that can be done about it. These are the people that say "I hope the bomb falls right on my head." They deny the effectiveness of good Civil Defense.

Fourth, some people want to hire someone else, beside themselves, to do Civil Defense work. They point to the Army. Or, they assume that "George" will do it. The fact is that there is not enough money to hire enough people to do the job. In the final analysis, whether you or I live following atomic attack largely depends on what you and I do. There

On Our Cover

Jones & Laughlin Steel Corporation recently staged complete mock shutdown for Civil Defense. Here, motor inspector checks out tandem mill control board.

In the final analysis, whether you or I live following atomic attack depends on what you and I do. There are not enough men or money to do it for us. . . .

This is damage pattern for a five megaton (equivalent of TNT) bomb. Interested observers report frequent casual talk about 20 megaton bombs, at least.

are not enough men or money to do it for us.

Finally, Americans simply do not know what war is, with the exception of those who recently have fought overseas. But the general population has seen no sign of an invader since 1814. Consequently, they do not feel the urgency of Civil Defense as do those who have seen invaders within their own lifetimes.

We can dispense with Civil Defense on that happy day when man can learn to live with man in permanent peace, or when the military can guarantee that no enemy can put a finger on the United States. Looking at either of these propositions today, prudence requires that we be prepared. Though we have gone a long way, all I can say at this time is that we are inadequately prepared.

What YOU can do NOW!

GERALD R. GALLAGHER
Assistant Administrator
in charge of Technical Advisory Services, Federal Civil Defense Administration (as told to Harold A. Bergen, Editor)

YOU WHO ARE the power services engineers in industry can take action right now that will improve the Civil Defense Readiness of your plants and of the communities of which you are a part. You can increase your Civil Defense Readiness by following this 11-point program:

First: If you have in-plant generators, you can arrange interconnections between your plant's generating facilities and the local utility's grid so that you can feed power to the utility. This, in effect, makes your industrial powerhouse a standby source for the utility in time of emergency. If a large concentration of generating capability is lost by damage to a utility central station, interconnections with scattered industrials in its area could provide the utility with standby capacity for essential services.

Arranging such interconnections costs some small amount of money, admittedly. But several industrial power plant operators have found such interconnections indeed profitable because they can then sell power to the utility during their off-peak hours. Their investment works for them more continuously. And everyone enjoys the bonus benefit of interconnection in time of emergency.

Economic help is available to ease the expense in making these interconnections. One possibility is obtaining authority for rapid amortization of the equipment involved. This authority is now being granted

Send Us Your Profile

You can profile your own Civil Defense Readiness in Power Services Standby by answering the adjoining questionnaire. THEN, send the filled-out questionnaire to us so that we can better plan our editorial program to help you improve your Readiness. Send us your Profile TODAY!

(fold this flap in first)

(fold this flap in first)

An INDUSTRY & POWER Profile
Standby Power For Civil Defense

1. We use steam for: mechanical power yes..... no.....
   electric generation yes..... no.....
   process heating yes..... no.....
   space heating yes..... no.....

2. Our steam supply is (circle one):
   (a) generated entirely in our own plant
   (b) partially generated in-plant and partially purchased
   (c) entirely purchased

3. Our steam boilers are:
   (a) gas-fired (how many?..... total capacity.....lb/hr)
   (b) oil-fired (how many?..... total capacity.....lb/hr)
   (c) coal-fired (how many?..... total capacity.....lb/hr)
   (d) multiple-fuel fired (how many?..... combinations?.....
   .....total capacity.....lb/hr)

FOLD HERE

4. Our electric power is (circle one):
   (a) generated entirely in our own plant
   (b) partially generated in-plant and partially purchased
   (c) entirely purchased

5. Our tie lines to our electric utility:
   (a) can supply all our plant load
   (b) can supply emergency load only
   (c) (can supply) or (cannot supply) electricity from our generators to the utility with our present interconnections

6. Utility can supply electricity over (circle one)
   (a) one line (b) two lines (c) three lines

7. Within our own plant, we have standby capacity of
   (a) diesel driven generators (how many?.....total capacity.....kw)
   (b) gas-engine-driven generators (how many?...total capacity...kw)
   (c) storage battery (excluding self-contained lighting units)
   (total capacity.....)
   (d) self-powered, self-charging battery lighting units (how many.....)

FOLD HERE

8. Throwover from normal to emergency electric power sources is
   (a) manual (b) automatic

9. If we lost all normal sources of power, we could sustain a minimum supply of emergency power for.....hours.

10. Our water supply is furnished (circle one)
    (a) entirely by in-plant sources
    (b) partially by in-plant and partially by municipal sources
    (c) entirely by municipal sources

11. We have emergency water supply for
    (a) firefighting (source:..... total capacity:.....)
    (b) sanitation (source:..... total capacity:.....)
    (c) process (source:..... total capacity:.....)
    (d) boiler water (source:..... total capacity:.....)

over

(fold this flap in second)

(fold this flap in second)

(moisten and seal)

12. Our plant wastes and sewage are (circle one)
    (a) completely disposed of in our plant
    (b) partially disposed of in our plant and partially sent to municipal system
    (c) all sent to municipal system facilities

13. Our emergency wastes disposal facilities consist of .....
.....

14. Of the total minimum capacity we need in standby power facilities, we now have the following amounts installed and in service
    (a) steam standby: .....% of minimum required capacity.
    (b) electrical standby: .....% of minimum required capacity.
    (c) water supply standby: .....% of minimum required capacity.
    (d) waste treatment standby: .....% of minimum required capacity.

My name..... My title.....

Firm name.....

Address of plant covered by this profile.....

City..... Zone..... State.....

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to defense-producing industries. Another possibility is granting of a loan by the Treasury Department under the authority formerly exercised by the Reconstruction Finance Corporation.

Second: You who are in the utility business can work toward improving the interconnections with neighboring systems. One of our greatest national assets is the dependability of electric service — due in large part to the ability to interconnect systems. Anything we can do to improve the capability to interconnect adjoining systems will improve the availability of essential power in time of emergency. An excellent example of such systems interconnection is the Southwest Power Pool.

Third: In your planning for the standby power needs of your own plant, you can gear your thinking to local, state, and national Civil Defense plans. Power Services engineers in any given area are, collectively, the best authority on what portable and stationary power can be made available in time of emergency. Who could better plan for power to serve the essential needs of the community at large than those individuals whose day-to-day job is delivering power?

This is another area of action where outstanding examples of actual practice exist today. Power Services engineers in many areas have already joined together in mutual aid associations to better prepare themselves for disaster. Some of the most successful Industrial Civil Defense Mutual Aid Associations are those in West Hudson County, New Jersey; Kanawha Valley, West Virginia; Niagara Falls, New York; Baton Rouge, Louisiana; and Waterloo, Iowa.

Fourth: As your plant's power system is modernized and extended, you can anticipate the bonus value in terms of Civil Defense Readiness that accrues from better physical protection of your power generating, switching, and transmitting equipment.

Fifth: In planning the physical environment of your plant, you can anticipate and provide for the evacuation of production personnel. You can plan priority of departure for your own Power Services personnel in case of evacuation so that shutdown can be orderly, and so that restoration of your power services can be orderly.

Sixth: You can become informed about what *could* happen in case of attack to the Power Services equipment for which you are responsible. Data is readily available that will help you determine the exact nature of your plant's vulnerability to disaster. By keeping continually informed about the factors that determine vulnerability, you can plan your plant modernizations and extensions to reduce such vulnerability.

Seventh: Together with your industrial neighbors, you can establish the type of maximum self-help mutual-aid organization that is already achieving maximum Civil Defense Readiness for its members. Many of the mutual self-help groups have cataloged their supplies of wire, cable, pipe, and so forth so that each member firm by itself and in concert with its neighbors achieves maximum readiness with what is already on hand.

Eighth: If you store combustible gases of any kind in your plant, you can plan to protect them from the thermal effects of nuclear explosion. Experience indicates that this can avert serious hazard.

Ninth: If you store noxious gases, you can plan orderly shutdown and protection from the hazards that would arise from uncontrolled release of these gases in time of disaster.

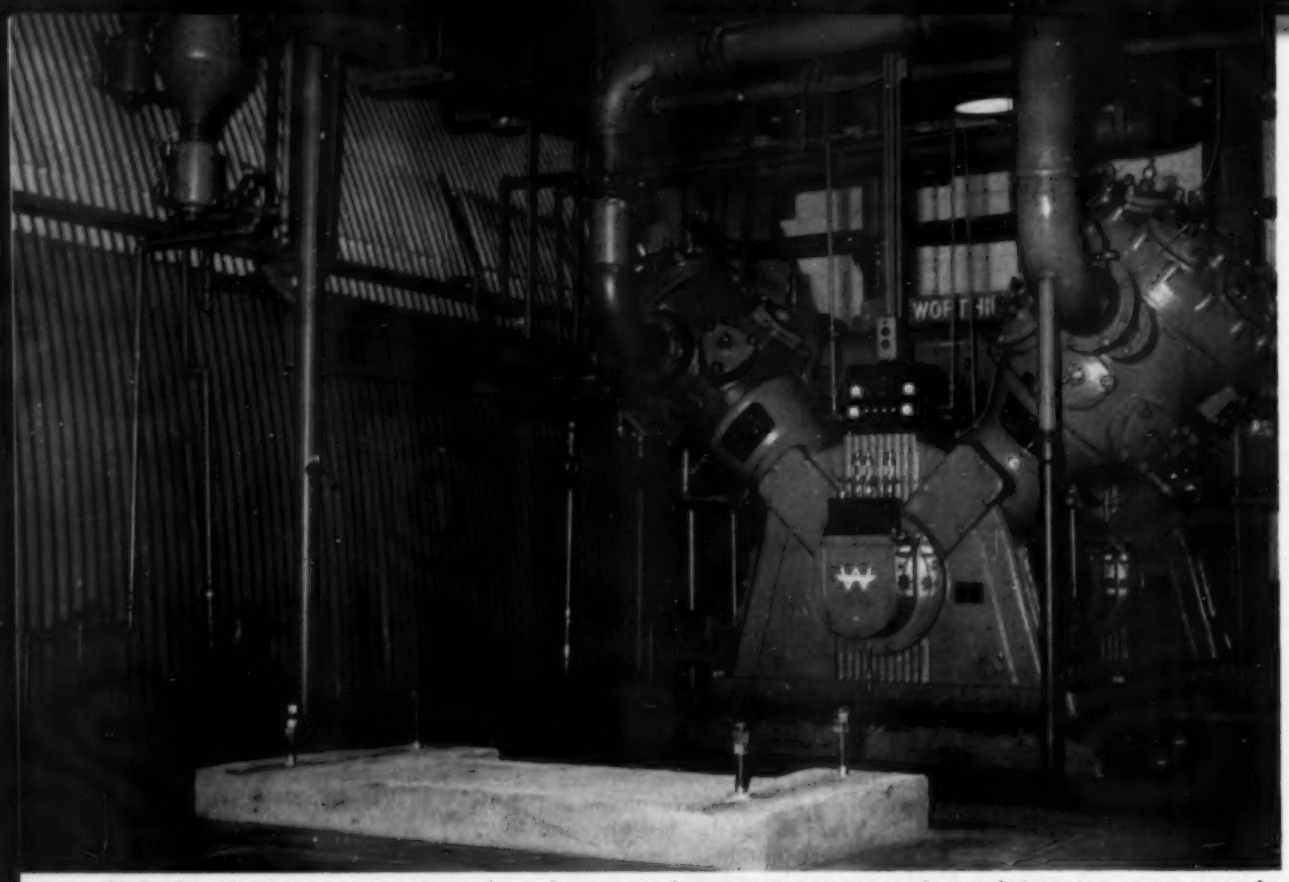
Gerald R. Gallagher

Tenth: You can tie in with the national plan for emergency distribution of fuels and lubricants now being worked out by the FCDA and the Department of Interior. The fuel stocks of industrial and utility plants will become part of the national inventory of fuel for essential services in time of emergency. This will affect you.

Eleventh: You can plan now for disposal of your plant wastes under emergency conditions. If normal disposal facilities are damaged, wastes might prove extremely dangerous unless plans are ready for handling them on an emergency basis.

Let me conclude by pointing out that we in FCDA can only advocate action. We cannot compel it. But, if you keep Civil Defense in mind in your planning of normal modernizations and extensions of your present Power Services facilities, you can make decisions that are economically and technically sound, with the bonus benefit of their being sound in terms of your Civil Defense Readiness.

SEND US your Power Services Standby Profile today! Data will help us plan editorial program for you. No postage required. We will be happy to have additional comment, too.



Cyclone moisture separator on aftercooler and automatic drain traps remove most of water before air enters surge tanks.

Improve supply, reduce maintenance with CENTRALIZED compressed air POWER

JOHN ANTHONY
Plant Engineer, Aircraft Division
Twin Coach Company

I&P EXCLUSIVE

MORE RELIABLE compressed air supply and reduced maintenance costs were achieved by centralizing air compressors. Air compressors formerly had been installed one by one in widely spaced locations as the Twin Coach Company, Aircraft Division plant in Buffalo, New York grew. It was proved that this was inefficient from the aspects of distribution and maintenance.

The plant uses many air-powered tools. Air power was formerly supplied by four compressors ranging in capacity from 250 cfm to 350 cfm. Each compressor was in a different location. The revamping was done to achieve the more constant air power characteristic of centralized installation.

A room was cleared near the plant maintenance department and two 800-cfm units were installed by Buffalo Electric, Incorporated with integrated modern controls and a new main distribution system. The compressors are Worthington 16/10½ x 7 Type YC-2 vertical angle compressors. They are fitted with water traps on the intercoolers, aftercoolers, and receiving tanks to remove as much moisture as possible. The pipeline-type aftercooler has a cyclone moisture separator and automatic drain trap.

Air intake is filtered through an Air Maze Model 18-M Viscous impingement-type air filter complete with weather hood. The two-stage, heavy-duty, water-cooled compressors are equipped with five-step variable capacity controls. They are directly connected to flange-mounted 150-hp, 600-rpm, three-

phase, 60-cps, 440-volt, 40-degree rise synchronous motors.

The compressors have McCord SF pressure-type lubrication with an oil pressure failure switch. This operates by opening the control circuit that shuts off the compressor when oil pressure drops. A mechanical feed lubricator is piped to all cylinders. Lube oil is cooled in a Worthington water-cooled heat exchanger that maintains the oil temperature at 130 F.

Cooling water for the compressors is supplied from the plant's own well. The water is at a constant 55 F temperaturee, so it is passed through the intercoolers first, and then through the compressor jackets to reduce thermal shock.

Tanks reduce surges

Two receiving tanks, 10 feet high by 42 inches in diameter, reduce surges. Welded compressed air mains with screwed branch connections practically eliminate line losses. Constant-pressure air supply is particularly important in the operations carried out in this plant. Controls are such that a pressure variation of more than two psig is almost unheard of at the receiving tank.

Centralization of the compressors has assisted the maintenance crew and eliminated tampering since the compressor room can now be locked up. It has also cleared space on the production floor.

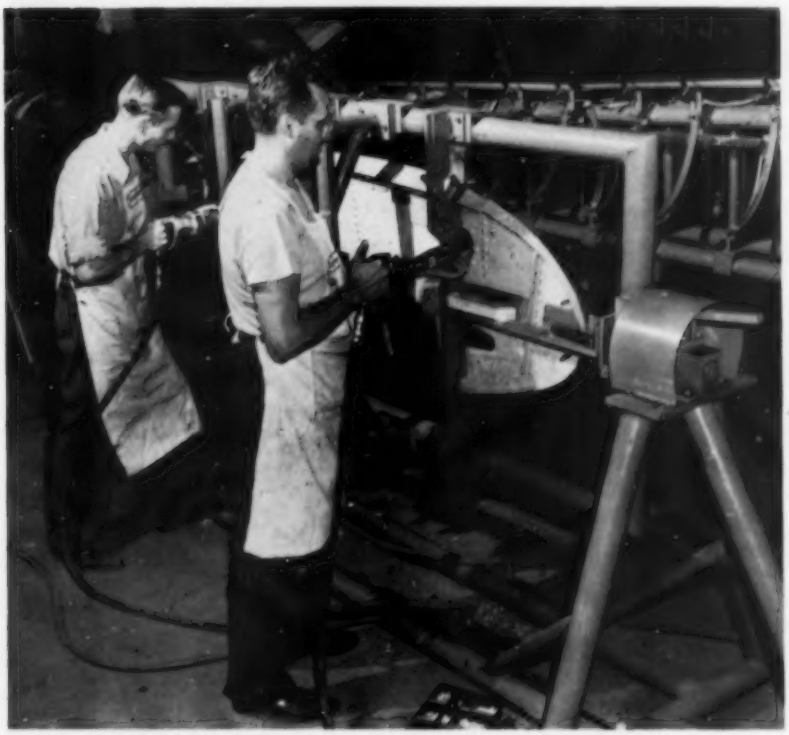
Need little maintenance

Only maintenance required so far has been checking of the feather valves. At first, this was done biweekly. But the inspection schedule has now been reduced to once every three months.

Production has increased considerably, particularly the riveting operations. Before centralization, air pressure was not constant and a great deal of time and material was wasted with reject riveting.

Another 800-cfm air compressor will be installed soon to further insure continuous air power in the plant. The two present compressors operate simultaneously only when sandblasting taxes the capacity of one. The third unit will function primarily as a standby compressor until rising production demands its full-time use.

Automatic control panel for main motors and motor-generator exciter are located next to compressors. Room can be locked to prevent tampering.



Air-powered tools demand constant-pressure supply, large stand-by capacity.

Centralization has reduced rejects.

How to EVALUATE decreased FUEL COSTS

I&P EXCLUSIVE

E. V. POLLARD
Medium Steam Turbine Department
General Electric Company

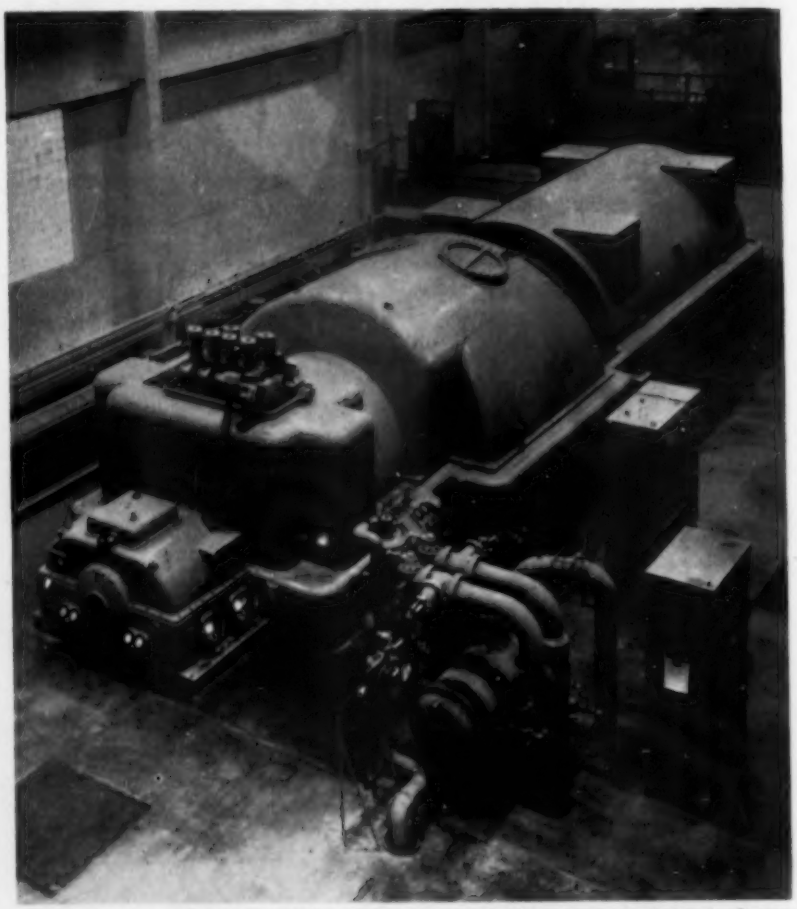
ECONOMICS OF NEW power, or power and process steam, generation equipment involve many factors. The intangible must be resolved by experience and judgement. The tangible can be expressed in terms of money. Questions like reliability of power source, flexibility of power generation equipment, and future possibility of equipment rearrangement to meet changing product demands are always debatable questions.

The influence of fuel cost, thermal efficiency, and capital cost can be expressed in dollars. Higher steam pressures and temperatures, and other thermal improvements decrease the annual fuel bill. They usually increase first cost of the equipment, however, on which taxes, interest, depreciation, and other fixed charges must be paid.

Power plant equipment is a long-range investment. Fuel prices are always on the increase. Hence, it is safe to say that equipment that is economical at present fuel prices will become more so in the future.

Since it is the difference in fuel costs that is to be evaluated, initial steam conditions must be selected for the steam turbine on which the comparisons are to be made. These initial pressure and temperature conditions each have essentially the same moisture content at the turbine exhaust: 450 psig at 750 F, 600 psig at 825 F, 850 psig at 900 F, and 1250 psig at 950 F. They are also the optimum conditions for turbines in their respective price ranges.

Let us start with the steam turbogenerator, since its thermal performance establishes the required capacity of boiler, piping, condenser, feed pump, and so forth. For a selected operating condition, the following steam turbine data is determined for each generator load under discussion: throttle flow, feedwater temperature, process steam flow (if any), condenser flow, and estimated feedwater heater requirements. A number of articles have been published in INDUSTRY & POWER that give step-by-step methods for finding pertinent performance data on steam turbines.* These methods are used to find the following comparable steam turbine performance which influences



Design steam conditions of turbogenerator must be known to evaluate fuel cost.

*"Calculation of Comparable Heat Rates of Steam Turbines," December, 1952.

"Heat Rate Correction Factors," January, 1953.

"Automatic Single Extraction Turbines . . . Effect of Full Feedwater Heating," March, 1954.

"Automatic Double Extraction Turbines . . . Effect of Full Feedwater Heating," April, 1954.

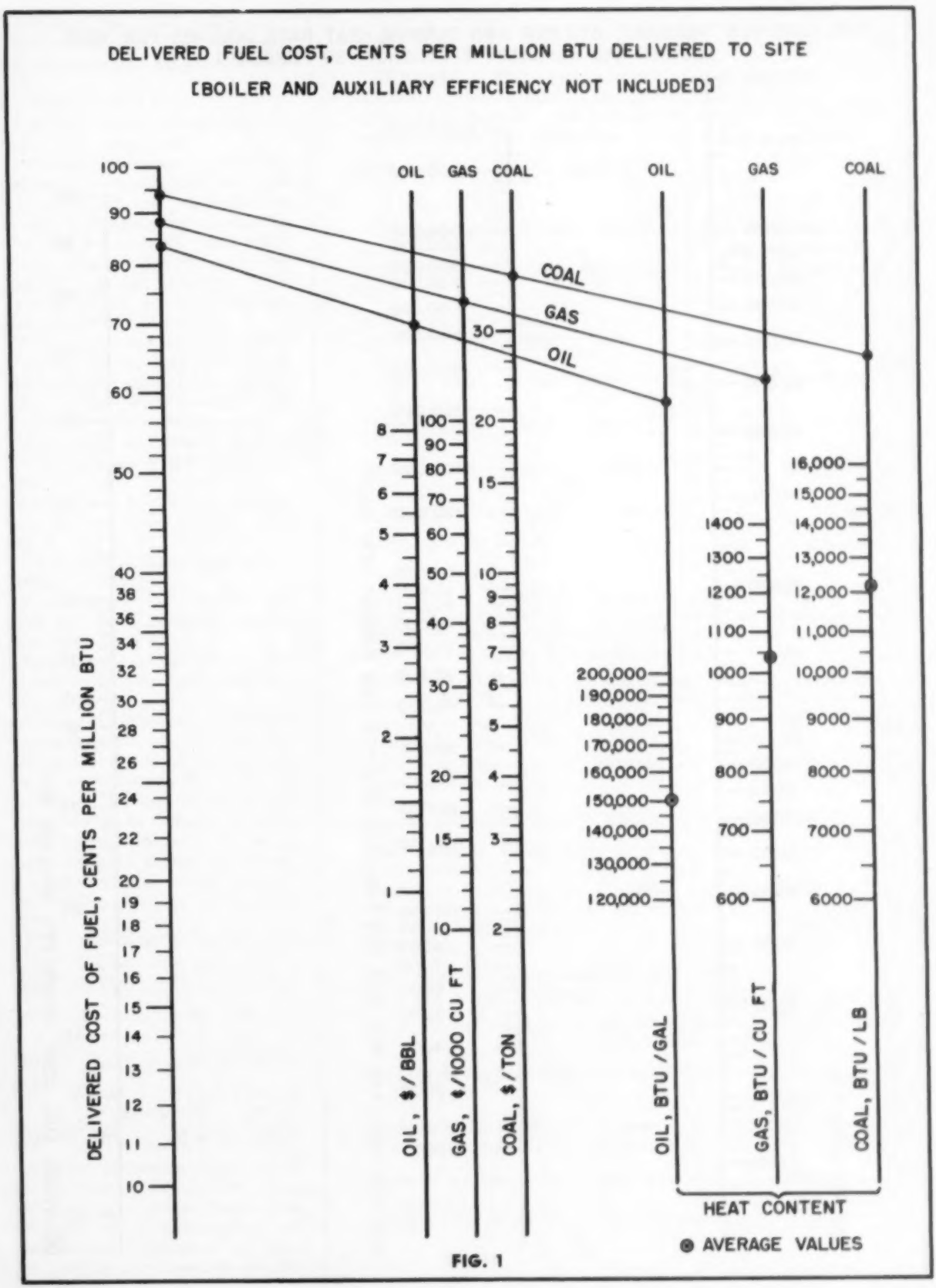

DELIVERED FUEL COST, CENTS PER MILLION BTU DELIVERED TO SITE
(BOILER AND AUXILIARY EFFICIENCY NOT INCLUDED)
DELIVERED COST OF FUEL, CENTS PER MILLION BTU
OIL
GAS
COAL
OIL
GAS
COAL
COAL
GAS
OIL
OIL, $/BBL
GAS, ¢/1000 CU FT
COAL, $/TON
OIL, BTU/GAL
GAS, BTU/CU FT
COAL, BTU/LB
HEAT CONTENT
⊛ AVERAGE VALUES

FIG. 1

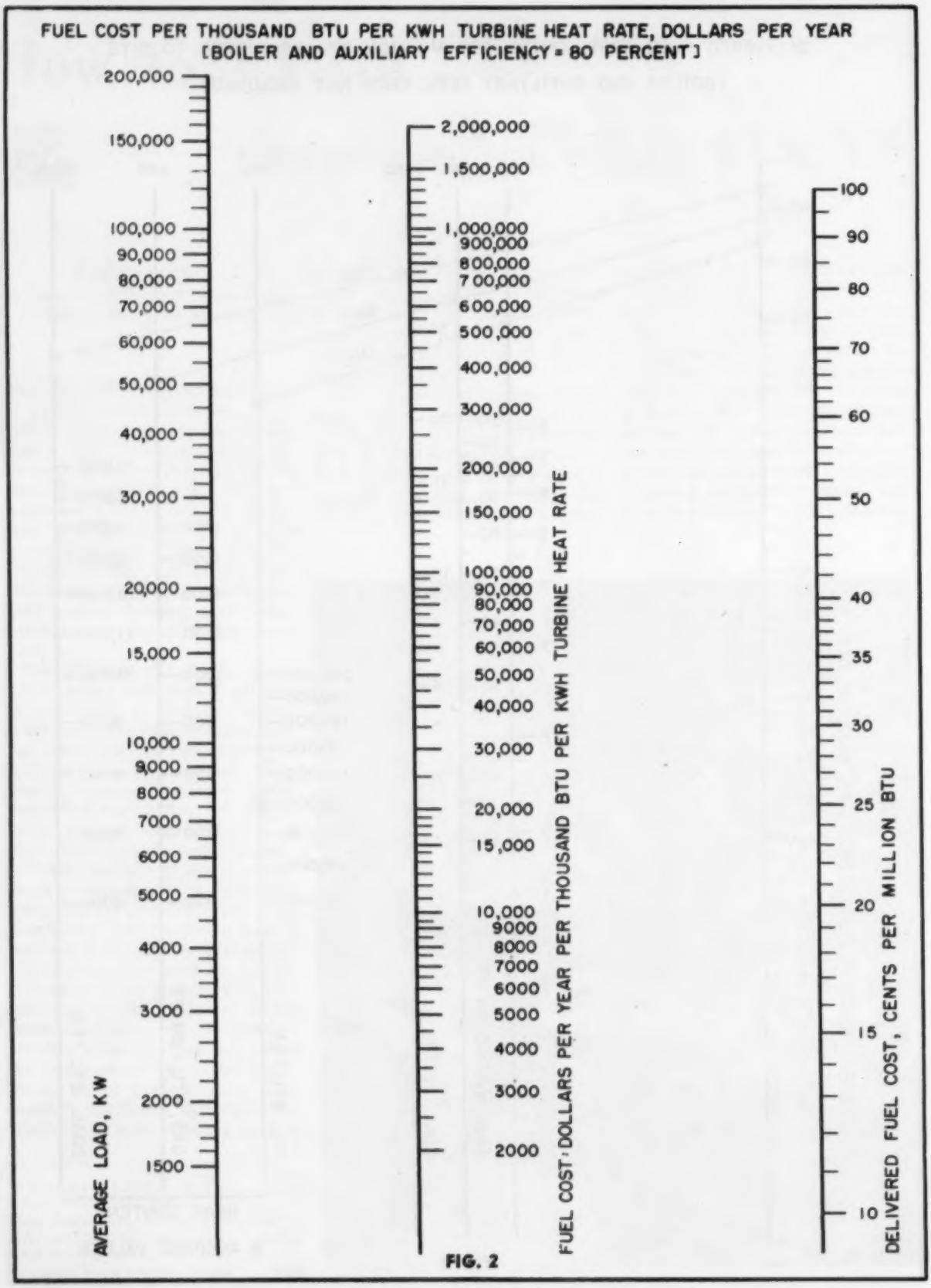

FUEL COST PER THOUSAND BTU PER KWH TURBINE HEAT RATE, DOLLARS PER YEAR
[BOILER AND AUXILIARY EFFICIENCY = 80 PERCENT]
AVERAGE LOAD, KW
200,000
150,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
15,000
10,000
9,000
8000
7000
6000
5000
4000
3000
2000
1500
FUEL COST: DOLLARS PER YEAR PER THOUSAND BTU PER KWH TURBINE HEAT RATE
2,000,000
1,500,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
150,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
15,000
10,000
9000
8000
7000
6000
5000
4000
3000
2000
DELIVERED FUEL COST, CENTS PER MILLION BTU
100
90
80
70
60
50
40
35
30
25
20
15
10

FIG. 2

the cost of the allied equipment:

¶ Throttle flow and final feedwater enthalpy — which influence boiler cost.

¶ Condenser flow.

¶ Feedwater flow—which influences boiler feed pump cost.

¶ Estimated feedwater heater requirements—which may be used for estimating cost of feedwater heaters (on the assumption that the final design may make changes that should total to approximately the original estimated values).

¶ Process steam that may be taken from an extraction turbine.

¶ Turbine heat rate (pounds/kwh), including finding fuel cost of station, and finding fuel cost chargeable to power when process steam is charged to other departments.

Four steps are required for convenient calculation of fuel costs per year:

¶ Find cost of fuel (cents per million Btu delivered to site) from Fig. 1.

¶ Find turbine heat rate (Btu/kwh).

¶ Find cost of fuel (dollars per year per 1000 Btu/kwh turbine heat rate) from Fig. 2.

¶ Find cost of fuel (dollars per year at each load), load factor, and heat rate. (See examples.)

Fig. 1 is read by using a straight line passing through the heat content and unit cost of a given fuel. The line intersects the delivered fuel cost. Transportation to the boiler should be included in boiler auxiliary requirements or as an operating labor charge. To convert the delivered fuel cost to cents per million Btu, we use these equations:

¶ Coal: $$\text{(Cents per million Btu)} = \frac{100 \times \text{(\$ per short ton)} \times 10^6}{2000 \times \text{(High heat value per lb)}}$$

¶ Gas: $$\text{(Cents per million Btu)} = \frac{(\text{¢ per 1000 cu ft}) \times 10^6}{1000 \times \text{(Heating value per cu ft)}}$$

¶ Oil: $$\text{(Cents per million Btu)} = \frac{\text{(\$ per bbl)} \times 100 \times 10^6}{42 \times \text{(Heating value per gal)}}$$

A word of caution in connection with the use of Fig. 1: The center and right-hand groups of scales line up from left to right — oil, gas, coal. Scales for the same fuel must be used in each case or disaster results.

EXAMPLE 1. Find yearly cost of fuel at average load on a 22,000-kw preferred standard turbogenerator with average load of 15,000 kw. Heat rate = 9782 Btu/kwh, and delivered cost of fuel = 40 cents per million Btu. Yearly fuel cost = \$66,000

$$[\text{from curve}] \times \frac{9782}{1000} = \$645{,}600.$$

EXAMPLE 2. Find yearly cost of fuel with yearly load divided among four loads on a 22,000-kw preferred standard turbogenerator, with delivered fuel cost of 45 cents per million Btu.

Kw Load	Hours Per Year	Heat Rate	Yearly Cost
10,000	1500	10,185	$49{,}000 \times \frac{1500}{8760} \times \frac{10{,}185}{1000} = \$\ 85{,}500$
15,000	3760	9,782	$74{,}000 \times \frac{3760}{8760} \times \frac{9782}{1000} = 310{,}700$
20,000	2500	9,657	$98{,}000 \times \frac{2500}{8760} \times \frac{9657}{1000} = 270{,}000$
22,000	1000	9,645	$107{,}000 \times \frac{9645}{8760} \times \frac{9645}{1000} = 117{,}800$
Total	8760		\$784,000

EXAMPLE 3. Find the break-even additional capital investment for a 25,000-kw automatic extraction turbine with 200,000 pound/hour process extraction at 50 psig and feedwater heating to 380 F at 25,000 kw load.

STEAM CONDITIONS SELECTED:	850 psig at 900 F and 2″ Hg Abs	1250 psig at 950 F and 2″ Hg Abs
Enthalpy at process extraction, Btu/pound:	1240.6	1231.0
Equivalent process extraction flow, pound/hour:	200,000	201,600
Throttle flow, pound/hour:	350,000	324,000
Heat added in boiler, Btu/pound:	1098.4	1112.7
Equivalent heat rate, Btu/kwh:	15,378	14,420
Heat rate reduction, Btu/kwh:		958

Fuel: Coal, 12,200 Btu/pound, \$8.00 per ton

From Fig. 1: Delivered fuel cost = 32.8 cents per million Btu

From Fig. 2: Fuel saving = \$89,790 per year per 1000 Btu/kw hour turbine heat rate

$$\text{Fuel saving per year with 1250 psig at 950 F} = 89{,}790 \times \frac{958}{1000} = \$86{,}020$$

Evaluation of fuel saving at 15 percent capitalization rate gives an allowable break-even investment increase for the higher pressure and temperature installation of $\frac{86{,}020}{.15} = \$573{,}500$, or $\frac{573{,}500}{25{,}000} = \$22.94$ per kw of installed capacity.

Fig. 2 is read by using a straight line intersecting the three scales. It solves the general equation. Fuel cost per year =
[(turbine heat) (hours per year) (load) (fuel cost)]/ (boiler and aux. efficiency)

For example, for each 1000 Btu/kwh turbine heat rate, 8760 hours per year, if boiler and auxiliary efficiency is assumed to be 80 percent, the fuel cost (dollars per year per 1000 Btu/kwh turbine heat rate) =
[(1000) (8760) (kw) (Cost of fuel, cents per million Btu)]/[(0.80) (100) (1,000,000)]

Two comments are pertinent to this equation. First, the fuel cost value was obtained on the basis of 1000 Btu/kwh turbine heat rate because differences in heat rate are being considered in some cases, and total heat rate is being considered in other cases. In either case, it is easy to correct to the final value using 1000 as a base. Second, a boiler and auxiliary efficiency of 80 percent is included in Fig. 2. Correction for different boiler and auxiliary efficiency may be made by multiplying the yearly fuel cost at a given load by 80 and dividing by the actual boiler and auxiliary efficiency at that load.

Yearly fuel cost can be determined in this way at each of the selected steam conditions, and the differences are found. Any differences is the financial saving (in dollars per year) for the higher initial pressure and temperature.

EXAMPLE 4. Find yearly fuel saving for 120 Btu lower heat on a 12,500-kw turbogenerator with average load of 9000 kw, and delivered fuel cost of 50 cents per million Btu. Yearly fuel saving = \$49,000 [from curve] $\times \frac{120}{1000}$ = \$5880

EXAMPLE 5. Find capitalized value of this saving with capitalization rate of 16 percent:

Capitalized value of yearly fuel saving = $\frac{\$5880}{.16}$ = \$36,750.

EXAMPLE 6. Find the saving in fuel cost chargeable to power for this 25,000 kw automatic extraction turbine with heat in process extraction flow credited to the turbine. (Process condensate returned to condenser.)

STEAM CONDITIONS SELECTED:	850 psig at 900 F and 2″ Hg Abs.	1250 psig at 950 F and 2″ Hg Abs.
Heat charged to process, Btu/pound	1171.5	1161.9
Heat charged to turbine, 10^6 Btu/hour:	384.44	360.45
Heat charged to process, 10^6 Btu/hour	234.30	234.24
Net heat charged to power, 10^6 Btu/hour	150.14	126.21
Heat rate for power generation, Btu/kwh	6006	5048
Heat rate reduction, Btu/kwh		958

Heat rate reduction for 1250 psig is the same as in Example 3, which is correct. Fuel cost chargeable to power is reduced \$86,020 per year as derived in Example 3.

When "capitalization rate" equals the sum of the rates for interest, taxes, insurance, obsolescence, and so forth in percent per year, then maximum additional investment in dollars per year that is economical with this fuel saving is:

$$\frac{\text{(Fuel saving per year) (100)}}{\text{Capitalization Rate}}$$

This is the maximum additional amount of dollars that may be invested in equipment that varies with initial temperature or pressure (such as turbines, boilers, piping, feedwater pumps, and high-pressure heaters) to just break even. This additional capital divided by the rated capacity (not specific load) becomes the allowable investment increase, dollars per kw, at the point of just breaking even.

From the above, and an inspection of Figs. 1 and 2, it is apparent that with the same heat rate saving (Btu/kwh), the actual economy may vary widely with local conditions — such as fuel price, load factor, and capitalization rate.

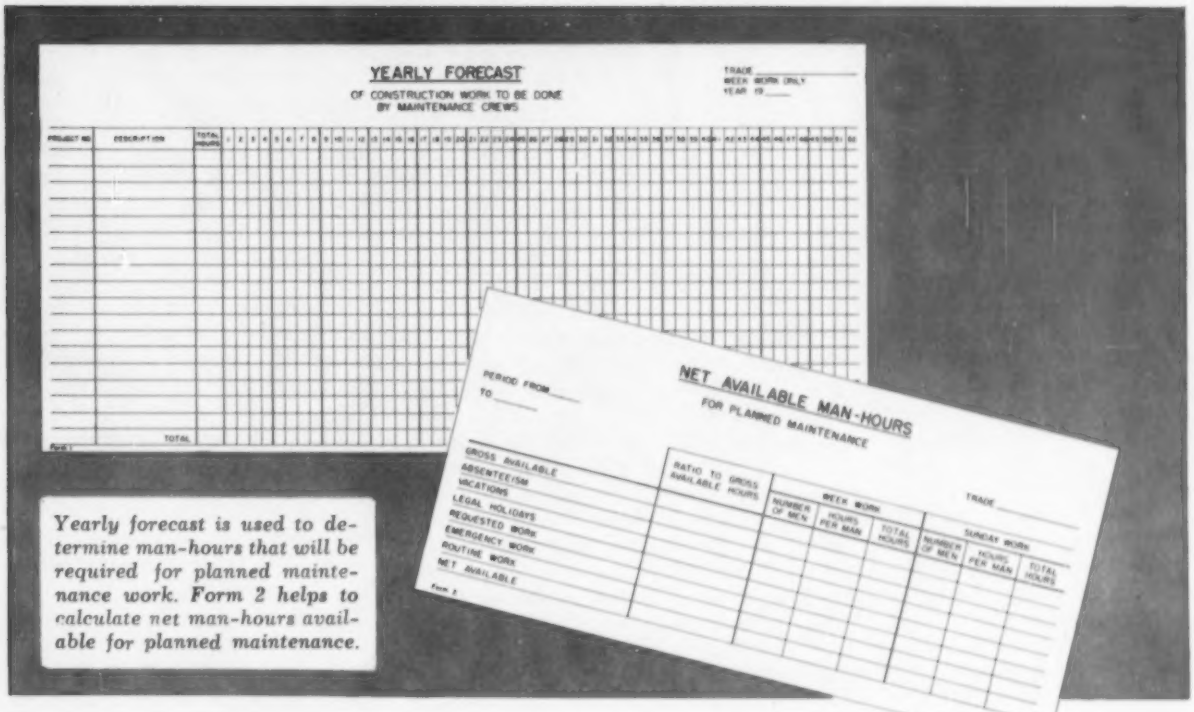
Turbine heat rate used

In the accompanying examples, turbine heat rate is used in every case. For noncondensing or process extraction turbines, there are two heat rates that might be used for a given set of conditions. The turbine heat rate that is used will depend on the information that is desired. For instance, if only fuel cost is under discussion, turbine heat rate

$$= \frac{\text{(throttle flow) } (h_o - h_f)}{\text{kw output}}, \text{ Btu/kwh}$$

where h_o = initial enthalpy of steam to turbine, and h_f = enthalpy of feedwater to boiler. If turbine heat rate chargeable to power generation is required for an extraction turbine, turbine heat rate (in Btu/kwh) = [(throttle flow) $(h_o - h_f)$ – (process extraction flow) $(h_x - h_r)$]/ (kw output)

where h_x = enthalpy of process extraction flow leaving turbine in Btu/pound, and h_r = enthalpy of return from process extraction flow in Btu/pound. If there is more than one process extraction flow, subtract similar expressions for each extraction flow. The turbine heat rate of a noncondensing turbine could be calculated by either of these two formulas.


YEARLY FORECAST
OF CONSTRUCTION WORK TO BE DONE
BY MAINTENANCE CREWS
NET AVAILABLE MAN-HOURS
FOR PLANNED MAINTENANCE
Yearly forecast is used to determine man-hours that will be required for planned maintenance work. Form 2 helps to calculate net man-hours available for planned maintenance.

How do you CONTROL Planned MAINTENANCE

I&P EXCLUSIVE

B. A. MARGO
Consulting Engineer

JUST A FEW forms, some metal cardfile signals, and a clerk are all that are needed to control planned maintenance in a mill that operates 24 hours a day and that has about 2000 pieces of mechanical equipment to be inspected, repaired, and overhauled. No fancy or expensive boards are used. Yet the complex problems that have always plagued planned maintenance have been solved.

Some of the planned maintenance (PM) work can be done during the week, but the bulk of it has to be done on Sundays, when machines are shut down. The fact that maintenance men are frequently needed for construction work complicates the situation and requires special planning.

In order to determine when and to what extent maintenance men are needed for construction work, a yearly forecast is required so that the final net available manhours for PM work can be calculated. To this end, those projects requiring maintenance men are listed on Form No. 1, one form sheet per trade. Total estimated hours are entered. The form has 52 columns, one for each week of the year. Estimated hours for each particular trade to work are entered in these columns. Then the hours per column are added up and entered in the last line.

Form No. 2 is used to calculate, for certain advance periods, how many hours the different tradesmen will be available for PM work. Again, one sheet is used for each trade. First, the gross available man-hours are figured out. These are broken down into work that can be done during the week (Week Work) and work that can be done on Sundays only.

Reserved time included

The next step is to reserve time for absenteeism and all the other reasons listed. Some of these reservations (such as vacations and legal holidays) can be calculated directly in hours. Others have to be calculated by means of a ratio relating these absentee losses to gross available hours. Existing work records have helped to establish these ratios. To take care of scheduled vacation times, a special sheet

is written up. The other reserved time is evenly distributed over the rest of the year.

Obviously, the net available hours calculated on this form is accurate only within certain limits. Absenteeism, requested work, and emergency work could require considerably more time at a given instant than anticipated. Compensating factor is a substantial reserve in the form of potential overtime. In addition, the maintenance office schedule clerk tries to keep under the theoretical limit of available hours when issuing job tickets to the maintenance crews.

Basic schedules

The form for listing the work in detail that has to be done is called a basic schedule, Form No. 3. Normally, one sheet is written up for one machine or piece of equipment. In some cases, it is possible to write one sheet for several units of the same type, depending upon the total estimated hours and the net available hours per trade.

Basic schedules receive consecutive serial numbers which are marked in the upper right corner. This is cross-referenced to the auxiliary schedules.

In the heading, there is a notation "Week - Sunday Work". Some jobs have to be started during the week so that spare parts can be installed on Sunday. The applicable words are underlined to suit.

At the start of the system, a distinction to be made between critical and noncritical machines and equipment. "Critical" is the definition for everything that causes an immediate loss of production in case of a breakdown. For such units, the word "non" is deleted.

The rest of the form is self-explanatory with one exception—the notation "Every x weeks." The maintenance engineer who (in close cooperation with the trades foremen) writes up the basic schedules, has to enter in this column the intervals at which the job should be repeated. These intervals have been standardized to 4, 8, 16, 32, or 64 weeks. This arrangement permits jobs with different intervals to be combined. For instance, if Job No. 1 has to be done every 4 weeks and Job No. 2 every 16 weeks, the two jobs can be done simultaneously every 16 weeks. This saves time in the maintenance office and for the maintenance crews. Any jobs to be done at smaller intervals than four weeks are called routine jobs. Permament job tickets are issued for them. Such jobs are not listed on the basic schedules.

Auxiliary schedules

Form No. 4 was designed to simplify issuing job tickets by the schedule clerk. This form has a dateline for positioning metal signals along its upper edge. Numbers 1 to 52 represent the 52 weeks of the year. One of the schedule clerk's jobs is to put a metal signal on each form as a reminder that new job tickets have to be issued. The week for which new tickets are to be issued is shown in the body of the form. Job numbers are entered in the weekly columns at the intervals shown on the basic schedules. This can be done for two years in advance.

When this system is first established, a decision has to be made as to when each job should be done for the first time. Certain overhaul jobs may have just been performed, so the corresponding job number is entered a year ahead. If an inspection job is due during the next week, the job number is written down under the corresponding week number. The signal is positioned at the same number. If this is a job that has to be repeated every four weeks, the schedule clerk, after writing out the job ticket, moves the signal four weeks ahead.

These auxiliary schedules are best kept in an open file, in the sequence of basic schedule numbers. Numbers are also entered in the equipment list, which is kept in sequence of equipment numbers. This arrangement prevents duplication of work.

Before the installation of the PM setup, repair jobs may have been done on request. Requested jobs are taken over as much as possible by PM work. During the transition period, it is important to find out if certain requested jobs are scheduled to be done in the near future as PM jobs. With basic schedule numbers listed in this way, and with auxiliary schedules kept in sequence of basic schedule numbers, it is easy to trace the numbers and the auxiliary schedule in question.

As soon as all auxiliary schedules are written up, a master schedule, Form No. 5, is prepared. For each trade, two sheets are written up — one for work to be done during the week, another one for work to be done on Sundays. All basic schedules are scrutinized with respect to the trades mentioned on them. For example, if Basic Schedule 115 shows that Job No. 1 has to be done by the machine shop, these numbers must be listed on the sheet for the machine shop. Next step is to write down the estimated work-hours for the job under the week numbers shown on the auxiliary schedule. After transferring this information completely, weekly totals are made.

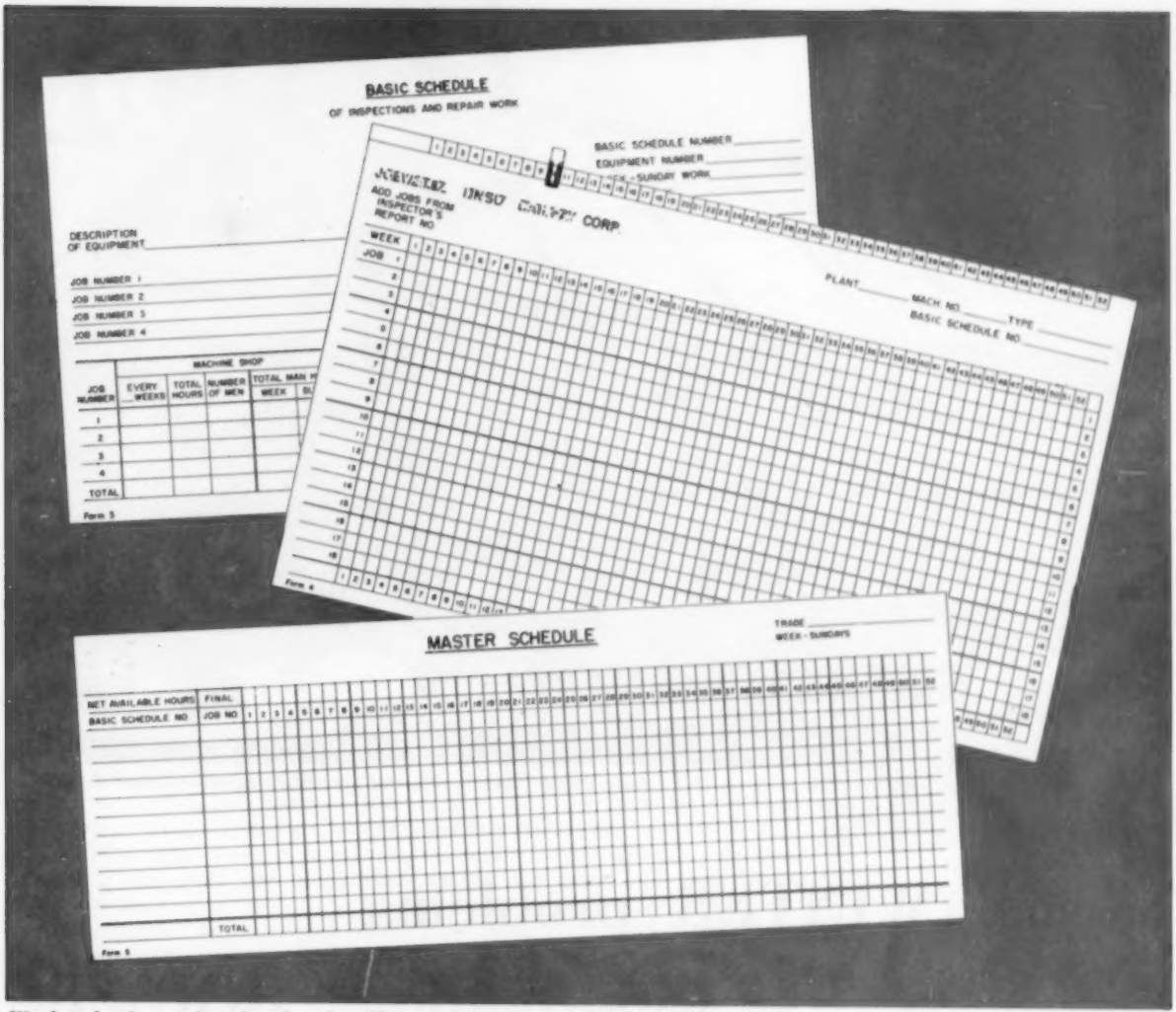
These totals are the estimated work-hours for each week and each Sunday of the year. Totals are compared with the final net available hours per week and per Sunday. To this end, the totals shown on Form No. 1 (yearly forecast for construction work) are deducted from the net available hours shown on Form No. 2 (net available man-hours) for the weeks in question. The final net available man-hours are then entered in the line provided on Form No. 5 (master schedule).

When comparing the total estimated work-hours with these final net available man-hours, overloading in some cases becomes evident. This has to be remedied by moving starting dates of certain jobs ahead.

Finally, the master schedules are used to establish the total estimated week and Sunday workloads per trade for a whole year. This is done by simply adding up all the totals in the last line of the form. These grand totals provide important information to management about the extent of P M work.

Followup card

Work orders for PM to be done on Sundays are issued in form of worksheets, with all jobs listed in detail. Sunday work does not cause any difficulty so far as followup is concerned. The situation is different for PM work to be done dur-



Work to be done is listed in detail on Form 3. Form 4 reminds clerk to issue job tickets, and Form 5 is final schedule.

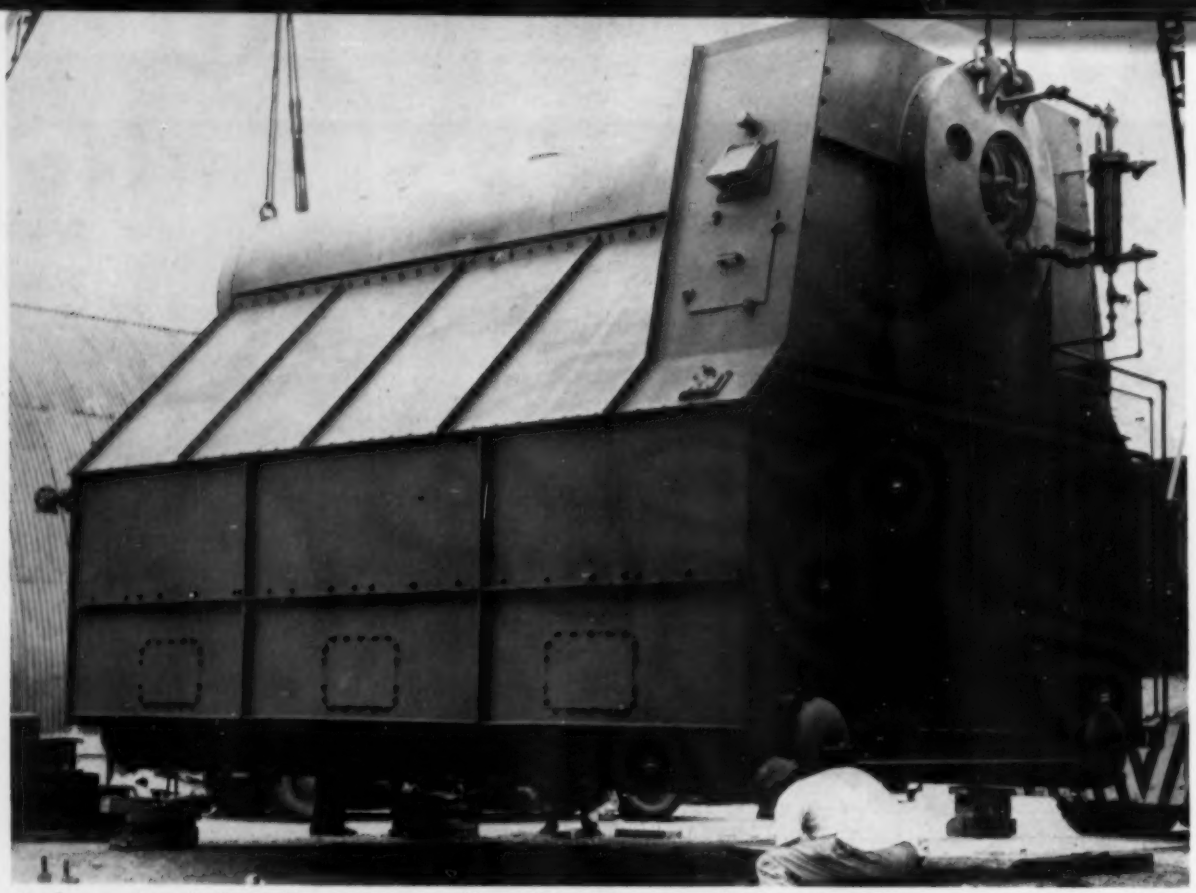
ing the week. For this type of work, it is not practical to give definite completion dates to the trades foremen. Since several hundred job tickets are in operation simultaneously, some means of followup is required. This is accomplished by using a followup card, Form No. 6.

The followup card has a dateline with numbers from 1 to 31 for the days of the month. One card for each job is put in an open box behind the job ticket copy that is available for followup purposes. Whenever the schedule clerk issues a job ticket with the tentative completion date marked on it, he puts the followup copy of the ticket in the open file with a Form No. 6 card behind it. Then he puts a green metal signal on the date when he expects to receive the job ticket back as indication that the job has been completed. If the job ticket has not been returned by this date, he consults the trades foreman in question. He then puts a red signal on the revised completion date and replaces the followup copy of the job ticket as well as the followup card.

These forms are kept in an open file in sequence of job ticket numbers, so that the schedule clerk can find the followup copy as soon as he receives the original ticket.

This followup system has a self-controlling feature that might be useful in several applications. The metal signals indicate the date by which a certain action (in this case completion of a job) should have been reported. If it has not been reported, the schedule clerk finds the signal still on the current date and he follows up the matter. If he falls down on the job and does not move the signal, the file would show at a glance that a signal was still standing on a previous date. Since the clerk has to make notations in code on the followup copy of the job ticket about the action he has taken, it is always possible to check whether he does his work properly or not.

This control system has solved several problems that are common to PM setups. The kind and shape of the forms is incidental. But the information needed, the actions to be taken, and the logical development from step to step can be quite similar in all kinds of plants, both large and small.



Outdoor package boiler itself presents no problems during winter. Auxiliaries and pipelines are major trouble sources.

Special WINTER problems with outdoor BOILERS

I&P EXCLUSIVE

D. W. KARGER
Chief Plant and Industrial Engineer
The Magnavox Company

FREEZING TEMPERATURES give vexing, though minor, problems to outdoor boiler installations. Solutions to these problems may be simple enough, but winter problems are quite troublesome until properly solved.

We had installed a Wickes 250-horsepower, package, A-type, water-tube boiler with a spreader stoker. We erected a housing over the firing bay. This housing has a very low roof because it was intended merely to cover the stoker and instrument installation. The roof blocked our view, and we had to install a remote water-level indicator. Water lines from the level indicator to the boiler drum soon showed signs of freezing since there was no active circulation of water. Merely wrapping them in insulation did not provide sufficient protection from freezing weather. (A minimum temperature of 9 F was reached during the first winter of operation.) It was evident that we either had to introduce some heat around these pipes or else enclose them in a housing.

Since the sight glass and automatic low-level water cutoff instrumentation were also involved, we built a very small sheet-metal enclosure on the roof of the small building in front of the boiler.

It is recommended that anyone installing an outdoor boiler in a climate similar to ours take into account this small additional housing. It is entirely possible that the overall cost could have been reduced by installing a peaked roof over the small building to enclose the front of the boiler steam drum as part of the building, rather than having a supplementary housing.

This statement was substantiated when the automatic feedwater regulator also was found to need supplementary housing. This unit is

mounted on the side of the boiler. We found that cold weather materially changed its characteristics. Some of the water lines associated with it froze. The regulation valve was broken as a result of ice formation within its cavity.

To ensure proper operation, an enclosure was built around the regulator. Infrared heat lamps were then installed inside for operation during extremely cold weather, but these have since been removed. We insulated the housing, and the regulator is now working well — even on the coldest days. We believe that this unit could have been moved to the front of the boiler and installed under the peaked roof.

Boiler is no problem

The boiler, as purchased from the manufacturer, is well insulated. In our opinion, it is adequate in every respect. Originally, we were somewhat concerned by the fact that the mud drums were partially exposed. We expected them to be subjected to excessive heat loss. After calculating the amount of heat loss, we decided that it would not be worthwhile to provide insulation to the small area exposed because of the difficulties with cleanout holes located in the ends and along the sides of the drums.

It is highly recommended that very careful consideration be given to all pipes carrying water (either hot or cold) in freezing climates. Merely wrapping the pipes with insulation does not protect them.

In order to get through the winter months, we purchased several lengths of resistance heater wire. This provided a quick and cheap solution to the problem. We have since installed permanent wiring to the heaters and their operation is checked periodically with an ammeter. We also covered the heaters with permanent outdoor pipe insulation. Another approach would have been to pipe live steam along these lines underneath the insulated covering, or else to use the discharge from our automatic blowdown equipment.

No protection was required for the Madden blowdown meter or its discharge line.

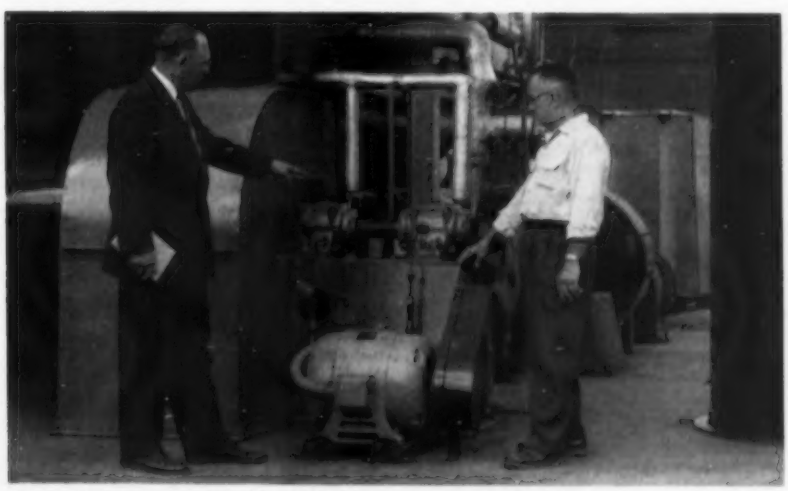
If you are installing an outdoor boiler, be sure to include necessary protection for any blowdown legs from the mud drums. Although these legs are relatively large, they still tend to freeze in extreme cold.

If a hydraulic control is used, be sure to charge it with special oil for winter use. Ordinary hydraulic oil will thicken to the point where it will flow only with difficulty during very cold weather.

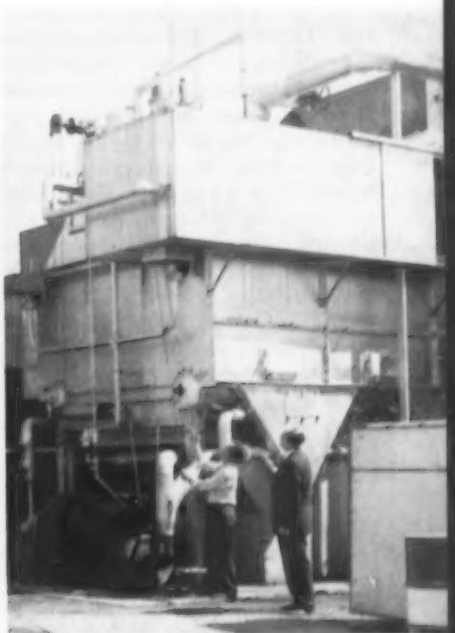
The result of these precautions and corrections has been successful operation. Even during the first winter, we never lost load. Over the past year, our only problems have been a plugged overfire air port, a leaking pump gasket, some bad slagging coal, and the failure of a motor bearing—none of which are winter problems. They could happen to anyone at anytime.

Only firing bay (with stokers, switches, and controls) is inside housing.

Feedwater regulator was protected with a plywood box for first winter.

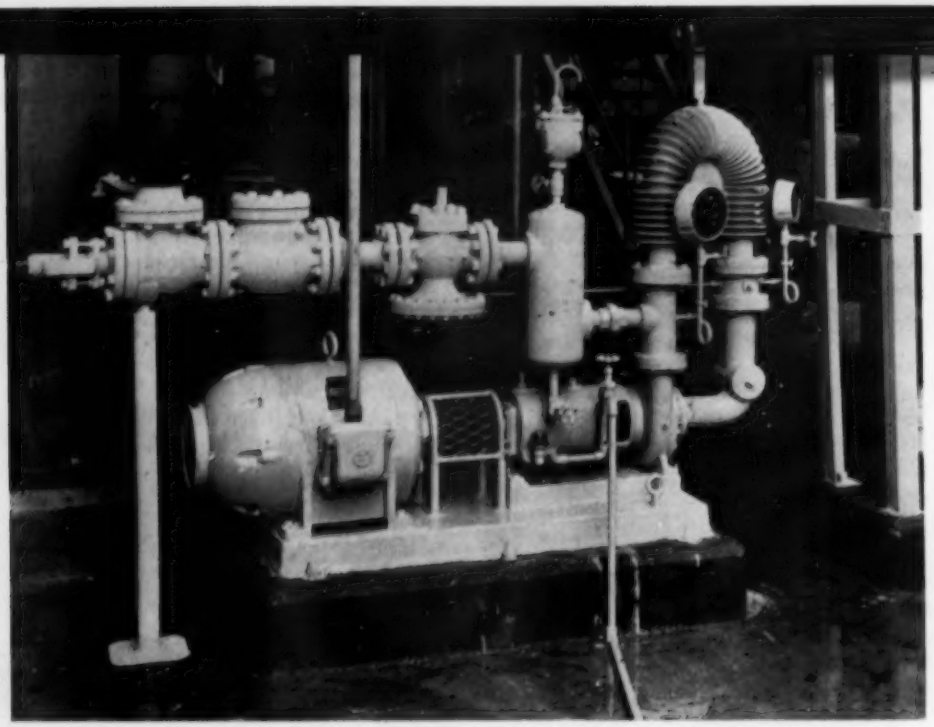


There has been no trouble with blowers or motors, which are not protected.



Sheet metal now replaces wood box.

I&P EXCLUSIVE



C-B unit is a jet pump that improves latent-heat transfer in steam system.

Drainage control unit Reduces steam requirements

R. BURGESS
Cochrane Corporation

DIRECT RETURN of steam condensate at high temperature and pressure can save you money. Better drainage can increase production. A company in the Philadelphia area, for example, turned its attention to excessive steam consumption and found that an important demand on the steam supply came from a six-stage conveyor dryer used to process titanium dioxide. Recognizing the potential of direct hot condensate return to reduce steam cost and of better drainage to improve latent heat transfer, company engineers decided to solve their problems with a device capable of these objectives.

Key to this high-temperature, high-pressure condensate return problem is a condensate booster drainage control unit — the C-B unit. This jet pump unit is also capable of creating higher latent heat transfer to the product by removing condensate film and gases more effectively. Thus the boiler need only restore latent heat, without having to supply sensible heat to the steam. Liquid and gases formed in the process unit are instantly removed by the C-B unit's jet action so that these elements do not have an opportunity to impair heat transfer to the product.

The dryer in this particular installation is a continuous-feed type, composed of six sections. The product is extruded onto a continuously moving drying belt where it is dried to a moisture content of less than one percent, the requirement for optimum quality.

Previous efforts limited

In previous efforts to obtain more production from the dryer, additional drying coils had been added so that maximum production could be realized within the physical limitations of the dryer itself. The condensate removal system was not changed. It was a conventional open type removal system, with individual traps installed on each coil section of the dryer. The traps discharged to a condensate header that, in turn, discharged to an open hotwell approximately 50 feet from the dryer.

The only consideration in the initial discussions was to minimize steam cost. It was felt that further increase in production would be difficult to attain due to the improvements that had already been made to the dryer. The dryer was producing approximately 50 tons of product per 24 hours. At some peaks, rates of 55 tons per day had been achieved for short periods.

In an attempt to eliminate losses in the hotwell and to achieve fuel economy, a return line 900 feet long was installed from the dryer

to the boiler room. Naturally, installation of a return line this long entailed some expenditure. Justification of this extra cost rested on the C-B unit's ability to handle high-temperature and high-pressure condensate without an intermittent flash-down, and to discharge this condensate directly to the boiler while maintaining adequate drainage of the dryer.

Boilers at this plant are operated at 150 psi. Because of line losses between the boiler room and the dryer, pressure at the dryer itself ranges between 125 to 135 psi. The C-B unit was installed in the boiler room. The condensate header at the dryer was connected to a two-inch overhead return line 27 feet above the floor level. This is the return line that runs 900 feet to the boiler room. It is connected to the inlet of the C-B unit. The C-B unit discharges either to the deaerating heater or directly to the boiler. An emergency bypass to the heater is installed for standby or comparative operation.

New unit goes in operation

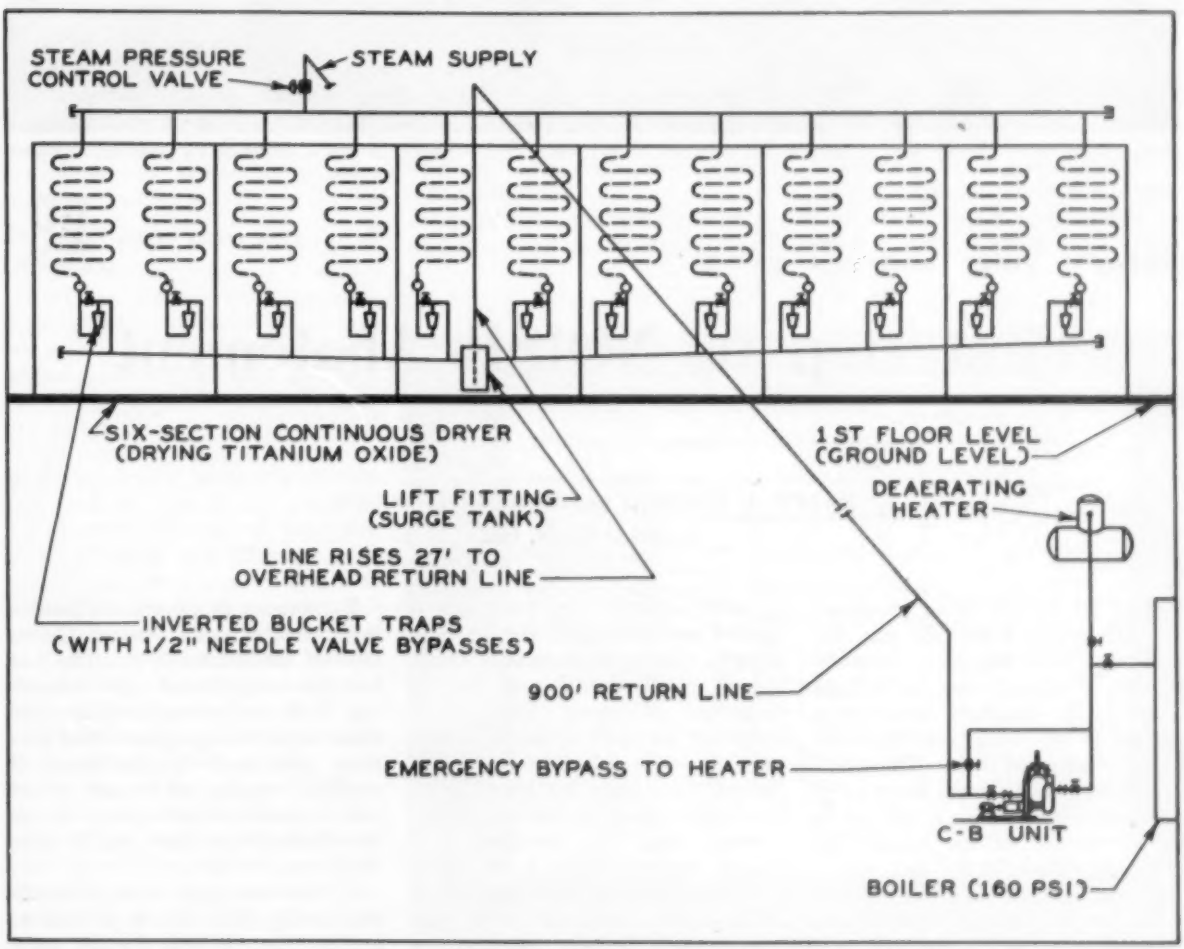
The C-B unit was put into operation with an inlet pressure of 70 psi. It discharged the condensate directly to the boiler at a temperature of 316 F. Discharge pressure on the C-B unit was 160 psi. This hookup immediately brought about substantial fuel savings. The returned condensate no longer "flashed down" to atmospheric pressure with resultant loss of latent heat.

Before the C-B unit was installed, the dryer used 9000 to 10,000 pounds/hour of steam to produce 50 tons of product. After installation of the C-B unit, the dryer only needed 6000 pounds/hour of steam while producing 65 tons of product.

Through the C-B unit's ability to increase latent heat transfer, maximum efficiency is now obtained from each drying coil within the dryer. This substantial increase in production is achieved over and above the improvements previously made while retaining the open drainage system.

Amortization in a month

The entire cost of the C-B unit installation is recovered about every 30 days of continuous operation through reduced steam costs and increased production. Steam costs are reduced 40 percent. Production of titanium dioxide is increased 30 percent. Product quality is assured. Water treatment costs and makeup requirements are considerably reduced.


STEAM PRESSURE CONTROL VALVE
STEAM SUPPLY
SIX-SECTION CONTINUOUS DRYER (DRYING TITANIUM OXIDE)
LIFT FITTING (SURGE TANK)
LINE RISES 27' TO OVERHEAD RETURN LINE
INVERTED BUCKET TRAPS (WITH 1/2" NEEDLE VALVE BYPASSES)
1 ST FLOOR LEVEL (GROUND LEVEL)
DEAERATING HEATER
900' RETURN LINE
EMERGENCY BYPASS TO HEATER
C-B UNIT
BOILER (160 PSI)

Schematic drawing of piping for condensate booster drainage control unit that has reduced steam costs 40 percent.

Noise measurement equipment is simple and economical. Magnetic tape recorder is useful addition for delayed analysis.

I&P EXCLUSIVE

Survey your sources as a

First step in NOISE Abatement

RALPH A. BIANCHI and ROBERT E. GOODE
Arthur D. Little, Inc.

WHAT IS YOUR noise problem?

To begin with, we can say that noise itself simply is "unwanted sound." Sound may be defined as a small pressure disturbance moving in an elastic medium such as air, water, or metal. The number of times per second these pressure disturbances reach the ear is the frequency of the sound (in cps). Magnitude of the pressure is the measurable quantity from which power, intensity, and sound-pressure level are calculated.

Much of the work already done in noise control has been aimed toward establishing abatement criteria — such as damage to hearing, speech intelligibility, and loss of operating efficiency. Even here, however, we have no single definition to state which sounds are "noisy." In some instances, low-level noises may be considered unwanted from the standpoint of mental concentration. Low-level hum or even a pleasant symphony, for instance, can be disturbing when you wish to concentrate on something else.

Equipment designers are becoming aware of noise control. Quietness of an industrial machine has become a significant sales advantage. Both equipment designers and those who use equipment find that noise abatement in the form of modified equipment design is not only a more direct way of approaching the problem, but is often the most effective.

The most common term in acoustics, and perhaps the most confusing, is the decibel. In its more general sense, the decibel merely

expresses the level of magnitude of a variable expressed in logarithmic terms. To take one particular example, let us look at the mathematical determination of sound-pressure level (SPL).

$$SPL = 20 \log_{10} \frac{P}{P_o}$$

This equation states that the sound-pressure level of a sound is directly proportional to the logarithm of the ratio of the sound pressure to a reference pressure. Similar definitions are used to calculate sound-intensity and sound-power levels.

Logarithmic definition of the decibel has been found convenient for two reasons. First, the definition allows for a convenient, compressed scale to report and plot. For example, variations in sound pressure as noted in any given case can involve a factor of 10, while the corresponding sound-pressure levels vary by only twenty decibels. Second, the human ear is a more-or-less logarithmic detector and, to some extent, corresponds to the decibel scale. Experimental charts and curves are available for interpreting decibels in terms of the reaction of the average ear to a sound. Table I gives some typical sound-pressure levels for various sources of noise.

Ear can't judge accurately

Since the loudness of a sound sensed by the ear does not conform strictly to the decibel, experiments on the human auditory sensation have provided the unit "phon" for loudness levels. Listeners judge that the loudness level of any sound in phons is equivalent in loudness to a pure tone of 1000 cps, and is numerically equal to the decibel readings of this pure tone. Fletcher and Munson have plotted equal-loudness contours as a function of frequency and sound pressure level. These curves (Fig. 1) show that the loudness level is equal to the sound-pressure level only at 1000 cps.

Psychologists have determined that people agree fairly well as to when one sound is twice, three times, or one-half as loud as another. Thus, they have defined the unit "sone." The loudness of a 1000-cps pure tone with a sound-pressure level of 40 decibels is called 1 sone. A pure tone that is twice as loud has a loudness of 2 sones.

Sound levels are the decibel readings that are obtained with standard sound-level meters whose weighting networks are based on the Fletcher-Munson curves, considering their variation with frequency and sound pressure.

General approach to noise

Most general approach to a specific noise problem involves making accurate measurements of the noise, analyzing the data to determine the character and possible causes of the noise, and devising methods for making a substantial noise reduction.

The only truly effective method of noise reduction is that which quiets the source of the noise. First attention should be given to finding out whether or not simple modifications of a machine can effectively reduce the noise. In many cases, the plant engineer already has the machinery in operation but is short of time, money, or the experience required to make the necessary modifications in machine design. He must then rely upon methods of noise reduction that are of a less fundamental nature — such as enclosures, mufflers, and surface treatment of rooms to reduce noise reflections.

Equipment required for an economical solution to many noise problems merely consists of a sound-level meter, microphone, frequency analyzer, and oscilloscope.

Fundamentally, the ASA-approved sound-level meter is of a nondirectional microphone, a calibrated attenuator, an amplifier, an indicating meter, and weighting networks to simulate the amplifier response of the human ear to pure tones at specified sound levels.

Although there are a variety of special-purpose microphones for low and high frequencies and amplitudes, most ordinary noises between 30 and 10,000 cps can be adequately measured with the rochelle-salt crystal microphone. When the sound-level meter and microphone are used as a unit, the meter indicates overall sound level readings. These readings are adequate if the frequency distribution of the sound is of no importance, or if it is of a single known frequency. For most applications, however, the sound is complex, and a frequency analyzer should be used with the level meter to determine the distribution of sound-pressure levels as a function of frequency.

Frequency analyzers

Octave-band frequency analyzers used in conjunction with the sound-level meter show sound-pressure levels in octave bands of frequen-

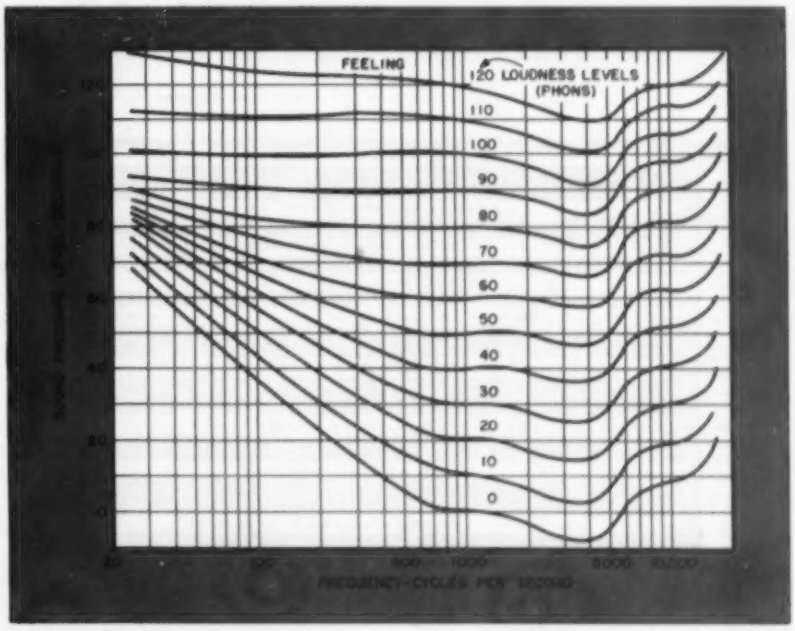


Fig. 1 — Equal-loudness curves show loudness equals sound pressure at 1000 cps.

cy. Since the standards of noise criteria with respect to speech interference and damage to hearing are given in octave bands, this type of analysis is most useful in establishing noise-abatement goals.

The constant-percentage-band width frequency analyzer isolates, within the specified percentage-frequency-band width, each component frequency of a complex sound, with respective absolute sound-levels for each frequency. This instrument is important in analyzing the specific sources that contribute to complex noise.

Oscilloscope sees noise

The cathode-ray oscilloscope is a standard piece of laboratory equipment used to analyze wave forms of complex sounds. In conjunction with a special camera, the oscilloscope also can take permanent records of such transients as impact noises.

Auxiliary equipment oftentimes found useful for specific noise analyses includes vibration pickups, tape recorders, and graphic level recorders. Many air borne sounds are produced from the vibration of solid materials through the exterior components of machinery. Vibration amplitudes and frequencies of equipment parts may be measured with vibration pickups so that the parts that need attention can be identified.

Magnetic tape recorders are useful for obtaining permanent records for detailed laboratory analysis. The graphic level recorder is a precise instrument that is valuable in recording noise levels as a function of time. It can also be used to record graphs of sound level versus frequency. Such complex auxiliary noise instrumentation should be used only with complete understanding of its limitations.

Source analysis

Having made noise measurements, the next step is to investigate the noise sources thoroughly. Whenever possible, an analytical study should be made to determine quantitatively the mechanisms of each source. These quantitative analyses are often possible. But many times, because of the lack of applicable theory, we must be satisfied with qualitative reasoning.

Noise sources may be broken down into three categories—aerodynamic, electromagnetic, and mechanical. Aerodynamic noise is generated in fans, propellers, and jets. Electromagnetic noise is generated in motors and other rotating electrical equipment in the air gap (where there is a discontinuity in magnetic flux) or in other electrical apparatus by the molecular motion of a magnetic core. Mechanical noise may be due to the forces exerted on solid materials or to the frictional drag between parts.

Reduction of noise in machinery has been given careful attention, but there is still a wide field for improvement. Where sincere efforts are made to reduce noise at the source, it is generally found that significant quieting can be obtained with only minor design changes. Frequently, noise limits the efficient operation of a machine. For example, wood planers used for pencil production are operated at a speed below their full capabilities because of noise limitations.

In some cases, relatively simple modifications for noise reduction lead to other advantages. For example, the improvement of cams so that their action is less impulsive will lead not only to lower noise levels but also to increased life. A cast-iron internal-combustion engine is quieter and cheaper than a welded-steel engine.

In some cases, noise reduction may be very difficult. Some compressors, air-conditioning units, and fans, for instance, have been subjected to such exhaustive acoustical studies that further improvement is difficult. Units such as saws, wood planers, and similar cutting machines operating at high speed are inherently noisy, since the mechanism necessary to do the work also makes the noise. Furthermore, one requirement for good operation—particularly small clearances—tends to accentuate the difficulty.

Sound absorption

Some consideration should be given to sound-absorbing techniques. Sound absorption is obtained with various kinds of porous materials. The principle involves conversion of acoustical energy into heat. Sound power given off by a source of noise is not reduced if the walls, floors, and ceilings are acoustically treated. Overall noise reduction in the space would be due to diminishing sound reflection. If the source of sound is a group of machines, very little relief is given to the machine operators themselves, since they are subjected to the direct sound, and are not affected by reflections.

Another principle of sound absorption is obtained with the use of electronic and mechanical sound absorbers. The electronic sound absorber consists of a bellows-type electron tube that picks up the complex noise. It then sends an electrical signal through an electronic circuit to a loudspeaker that produces an equivalent sound 180°

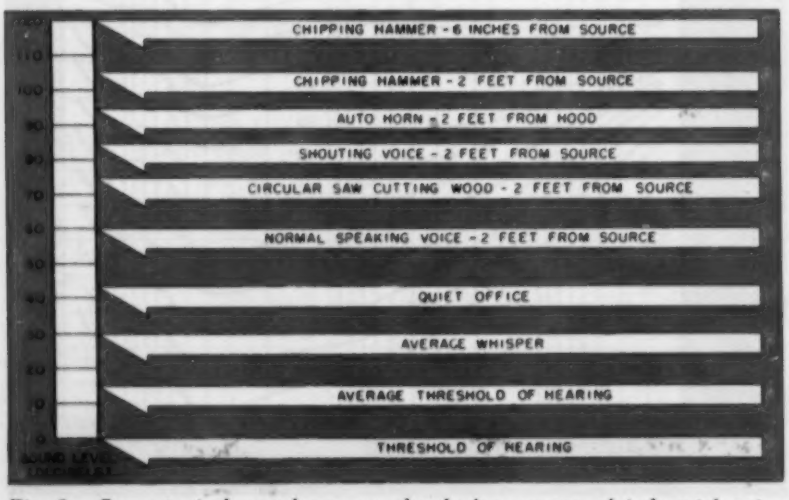

CHIPPING HAMMER - 6 INCHES FROM SOURCE
CHIPPING HAMMER - 2 FEET FROM SOURCE
AUTO HORN - 2 FEET FROM HOOD
SHOUTING VOICE - 2 FEET FROM SOURCE
CIRCULAR SAW CUTTING WOOD - 2 FEET FROM SOURCE
NORMAL SPEAKING VOICE - 2 FEET FROM SOURCE
QUIET OFFICE
AVERAGE WHISPER
AVERAGE THRESHOLD OF HEARING
THRESHOLD OF HEARING

Fig. 2—Some typical sound-pressure levels for sources of industrial noise.

out of phase with the sound source. This cancels the noise. This cancellation, however, can in a restricted area, and only in the lower frequencies of the audio range. Cancellation equipment also has the disadvantage of being costly and awkward to use. But this type of absorber is relatively new and may achieve wider recognition in years to come.

In some special cases, an air-column sound absorber may be effective. It is possible to construct a length of pipe such that the air column in the pipe vibrates 180° out of phase with sound source. This device is most effective when only one frequency predominates, since this air column cannot generate a complex sound for cancelling purposes. It is also important to place the air column very close to the source of noise.

Vibration isolation

A machine or one of its components may vibrate and excite surrounding structures, which in turn radiate a noise. The surrounding structure often can be isolated from the exciting member with soft mounts or isolators. Vibration isolation is used effectively when the excited structure is radiating more noise than the vibrating component of the machine. Such situations are common. For example, electric motors are isolated from their supporting structures to effectively reduce noise.

A noise source can be completely enclosed from its surroundings only when maintenance and operation are not hindered. However, certain kinds of equipment can be partially or completely enclosed. When ventilation or exhaust ducts are involved, they may be acoustically treated or mufflers may be inserted without impairing efficiency of operation. This technique has met with considerable success in air conditioning.

Psycho-acoustics

The effect of noise upon hearing, speech intelligibility, and efficiency in factories has received a great deal of experimental attention. In some states, damage-to-hearing cases have reached the courts, and compensation has been granted.

Physical effects of noise upon hearing are dependent upon the sound-pressure levels, the frequency, and the period and frequency of exposure. In general, sound-pressure levels above 140 decibels (such as occur near jet-engine operation) may cause immediate damage. However, sound-pressure levels as low as 85 decibels sustained over long periods of time (several years) may also involve a damage risk.

Hearing loss is a function of a person's age as well as of previous exposure to noise. Unfortunately, it is very difficult to separate the numerous variables, since many of them are of a statistical nature. Hence, factory noise levels should be kept within the most recent available data on noise criteria.

Another important aspect of psycho-acoustics is the noise criteria for speech intelligibility. It may be very important to the efficient operation of a plant to maintain certain areas at low enough noise levels so that conversation can be carried on fluently. Criteria are available, as a result of tedious experimentation, for allowable noise levels for various speech communication situations, ranging from telephone conversation to occasional communication which could be carried on by shouting. This data is available in many publications in the form of curves, charts, and tables.

Subject is controversial

The effect of noise upon human efficiency has become one of the most controversial topics in factory noise abatement. Results of experimentation disclose little conclusive evidence on the negative or positive effect of noise upon actual human efficiency. However, no loss of efficiency is known to result from reducing noise. Psychologically, the fact that the employer is concerned with the comfort and efficiency of the worker is reason enough to increasing morale and output. It is probably these very psychological considerations that make the subject so controversial.

Editor's Note: The authors have prepared an extensive bibliography. For a copy of it, write to INDUSTRY & POWER.

Effect of noise on safety

THE ANNOYANCE effect of unwanted sounds might be expected to depend largely on the individual differences of people — one man's "music" may be another man's "poison." But, in general, subjects exposed to intense noise for long periods, and noises in the middle and higher frequencies of the audible range, reported they felt more irritable than normally. However, the feeling of irritability did not necessarily limit the efficiency of their performance. . . .

Whatever relationship may be shown eventually between noise and safe performance, it is certain that noise has an influence on safety where it interferes with the workers' ability to hear established warning signals or to recognize such changes in the normal sound of certain machine operations that would presage impending hazard to the machine or its operator. For the present, there have been no expressions of recommended noise limits for the maintenance of safe performance environments, nor is there any evidence that consideration is being given the possibility of this factor.

Noise, because it is familiar to all and often annoying to most, has become a subject that many sensationalist writers choose to exploit. Noise is a problem for anyone who is responsible for its presence and the people who must listen to it — that is undeniable. But it is possible that when complete data are available, it will be found that the subject is somewhat less the physiological and psychological sensation that it has become. Therefore, until it can be clearly and unequivocally determined what the limits of noisomeness for noise might be, it would be best to approach the subject calmly, objectively, and quietly.

— John V. Grimaldi,
Accident Prevention Department,
Association of Casualty and Surety Companies, New York

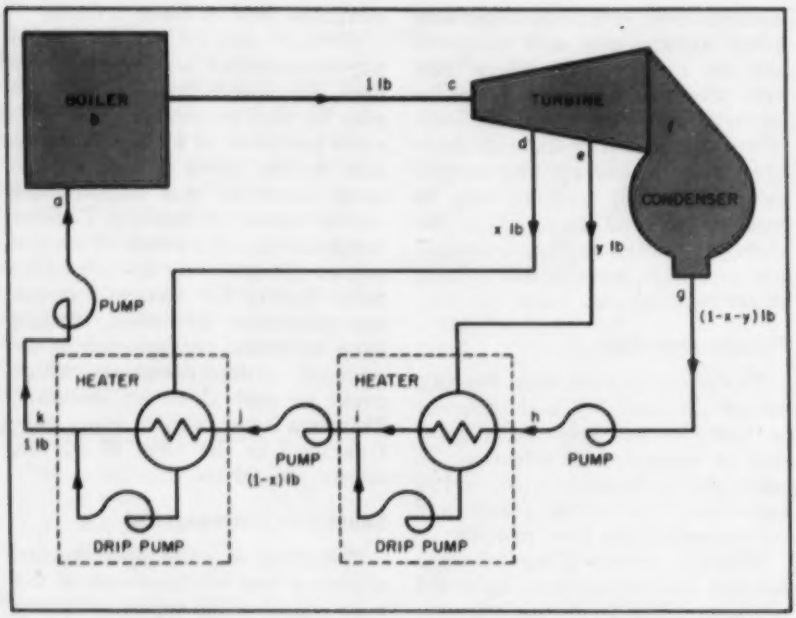


Fig. 1 — Vapor heat engine operating on crude approach to regenerative cycle.

A Thermodynamics Refresher— VI

The Regenerative Cycle

JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College

Start right here to review thermodynamics. Each article in this easy-to-read series stands as a story complete in itself. Single copies of this month's Thermo Refresher, as well as single copies of previous articles in the series, are available to readers without charge.

ALTHOUGH THE Carnot cycle is reversible, and therefore affords the highest efficiency, it is not practical. Rankine and reheat cycles have been shown to be practical but inferior to the Carnot cycle as far as efficiency is concerned.

Let us now examine another reversible cycle which, in theory, has an efficiency equal to that of a Carnot cycle, and which operates between the same temperature limits. This new cycle, called the regenerative cycle, has a very real advantage over the Carnot cycle in that it can be more nearly approached in practice.

The regenerative cycle

Aside from practical considerations, the main effort in modifying the basic Rankine cycle with superheat and reheat has been to increase the mean effective temperature at which heat is added. This is done by supplying relatively more heat near the upper temperature limit. But the mean effective temperature can be increased also by raising the temperature at which the liquid water enters the boiler — that is, by decreasing the amount of heat added at lower temperatures. The regenerative cycle offers this opportunity and at the same time eliminates, to some extent, the irreversible flow of heat that takes place if the condensed liquid is pumped directly into the boiler.

A somewhat fanciful conception of a completely reversible regenerative cycle is shown in the T-s diagram of Fig. 2. Heat is received isothermally from the source at T_2, and is rejected isothermally at T_1. Heat is rejected reversibly from *c* to *e* to an infinite number of reservoirs, each at an infinitesimally lower temperature ranging from T_2 to T_1. These reservoirs similarly supply heat reversibly from *f* to *b*.

What the individual paths *c-e* and *f-b* may be is of no importance. The only requirement is that corresponding points in the two paths have identical temperatures and slopes on a T-s diagram. We have now a reversible cycle, where all the heat received from the source is at T_2 and all the heat rejected to the sink is at T_1. The heat transfer between *c-e* and *f-b* is within the system, and hence does not cross the boundary. Consequently, the efficiency of the theoretical regenerative cycle is the same as that of a Carnot cycle operating between the same temperatures, T_2 and T_1.

This theoretical regenerative cycle is impossible to actually attain because:

¶ An infinite number of reservoirs is clearly impossible of even close approximation.

¶ The expansion from *c* to *e* is no longer adiabatic, and occurs with a marked decrease in entropy — thus seriously aggravating the problem posed by steam having a high moisture content.

¶ No physical arrangement is possible that could provide for the transfer of heat from the steam while it is doing work in the turbine.

¶ Even if such an arrangement were possible, the expansion of steam in a turbine is so rapid that the heat transfer could not even approach

completion before the steam left the turbine.

To achieve a practical regenerative cycle, we must sacrifice efficiency by introducing irreversibilities. A portion of the steam flowing through the turbine is withdrawn at a number of points along the flow path. The steam so extracted is condensed in a series of heat exchangers. These exchangers heat the condensate returning from the main condenser to the boiler. The arrangement is shown schematically in Fig. 1 for two extractions.

Effect of more heaters

The T-s diagram shows that as more heaters or extraction points are added, the temperature of the liquid entering the boiler at point *a* approaches the temperature at *b*, the highest temperature of the cycle. If one heater is used and steam is withdrawn from the turbine at a temperature midway between *g* and *b*, the irreversibility is reduced by one-half. If two heaters are used and steam is withdrawn at temperatures that divide the temperature difference between *b* and *g*, or *c* and *f*, into three equal parts the irreversibility is reduced by two-thirds. Thus the incremental reduction in irreversibility grows progressively smaller with the addition of successive heaters. Eventually a point is reached where any further increase in the number of heaters could not be economically justified by the corresponding improvement in thermal efficiency of the cycle. Normally, seven or eight heaters is the maximum number justifiable, and then only in a large installation with a large pressure range.

Special note should be taken of the T-s diagram of Fig. 3. The flow paths of the steam are represented, but in no sense does the area of the diagram bear any relation to the net heat added in the cycle. A close examination of the diagram shows that the actual regenerative cycle, so-called, is not a cycle at all but a combination of cycles. In fact, there are three cycles in the T-s diagram of Fig. 3 as follows: x pounds of steam experiences the cycle *a-b-c-d-k-a*, while y pounds and $(1\text{-}x\text{-}y)$ pounds of steam experience the cycles *j-k-a-b-c-d-e-i-j* and *h-i-j-k-a-b-c-d-e-f-g-h*, respectively.

To determine the heat and work transfers between system and surroundings, it is essential to consider the portions of the system that participate in these transfers. Hence, one pound of steam flows through the boiler and the heat added is $Q_A = h_c - h_a$.

Heat is rejected from $(1 - x - y)$ pounds of steam, or

$Q_R = (1 - x - y)(h_f - h_g)$.

One pound of steam does work from *c* to *d*, $(1 - x)$ pounds work from *d* to *e*, and $(1 - x - y)$ pounds work from *e* to *f*. Total work done in the turbine is

$$W_{turb} = (h_c - h_d) + (1 - x)(h_d - h_e) + (1 - x - y)(h_e - h_f) \quad (1)$$

Similarly, the total work done by the pumps is

$$W_{pump} = (h_a - h_k) + (1 - x)(h_j - h_i) + (1 - x - y)(h_b - h_g) \quad (2)$$

From the foregoing relationships, the thermal efficiency may be expressed

$$eff_{th} = \frac{Q_A - Q_R}{Q_A} = \frac{(h_c - h_a) - (1 - x - y)(h_f - h_g)}{h_c - h_a}$$

An alternate expression for the thermal efficiency may be obtained from the ratio of the work done in

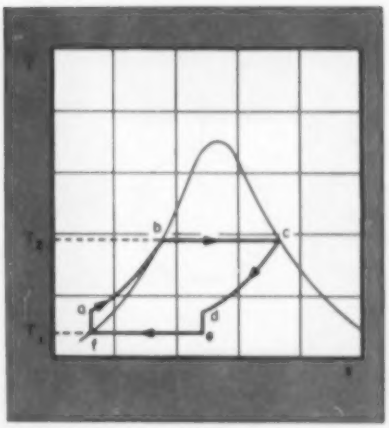


Fig 2—Theoretical regenerative cycle.

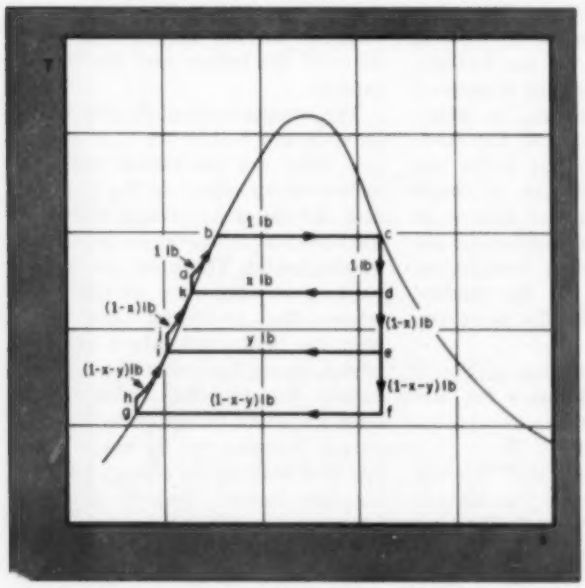


Fig. 3 — Regenerative cycle is really combination of cycles.

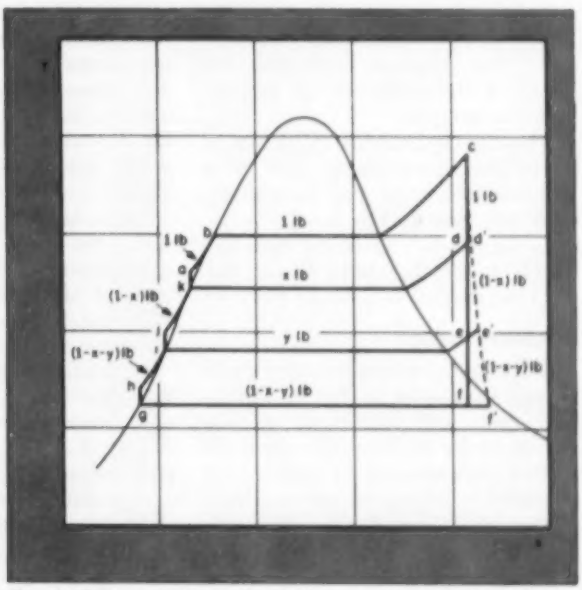


Fig. 4—Regenerative cycle with superheat on T-s diagram.

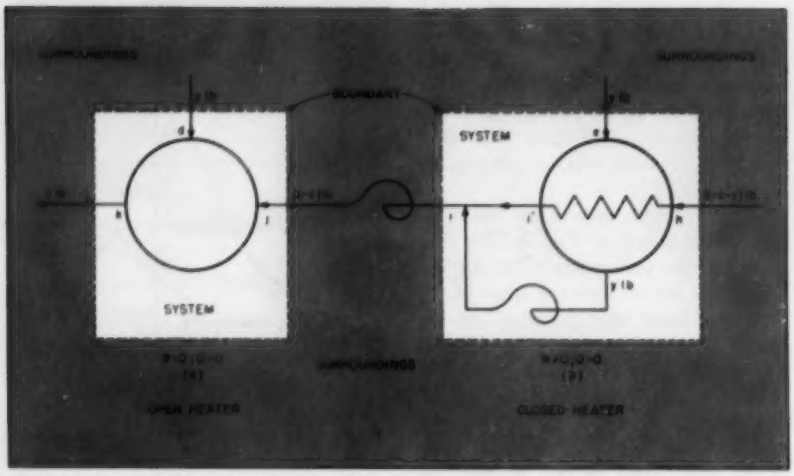


Fig. 5 — In closed type feedwater heaters, steam and water are kept separate.

the cycle, as given by the difference of Eqs. (1) and (2), to the heat added, Q_2.

The regenerative cycle is subject to the same limitations on its highest temperature as are the others, and steam of high moisture content must be avoided in the expansion process. It is necessary to superheat the steam, therefore. If a high evaporation pressure is employed it may be necessary to also reheat the steam for the same reasons as applied to the reheat cycle. The analysis we made of the regenerative cycle without superheat is equally appropriate, the superheat being neglected in locating the extraction points for optimum reduction in the irreversibility of the heat addition process. Fig. 4 shows a regenerative cycle with superheat on a T-s diagram, including the effect of irreversibility in the expansion process.

The internal engine efficiency of a turbine operating as part of a regenerative cycle may be written, with reference to Fig. 4:

$$\text{eff}_{int} = [(h_c - h_d') + (1-x)(h_d' - h_e') + (1-x-y)(h_e' - h_f')] / [(h_c - h_d) + (1-x)(h_d - h_e) + (1-x-y)(h_e - h_f)]$$

Efficiency is high

Efficiency of a regenerative cycle is high compared to that of a Rankine cycle with superheat, or to a reheat cycle, because the mean effective temperature at which heat is added is increased materially.

Now let us consider the efficiency of source and cycle together. In the regenerative cycle, liquid enters the boiler at a higher temperature. So the lowest temperature at which the combustion products leave the boiler is substantially increased. Unless measures are taken to improve the performance of the boiler and furnace, the efficiency of cycle and source together may be considerably lower than the corresponding efficiency of a Rankine cycle and its source. The practical solution is to employ an air preheater, as previously described, so that in effect the efficiency of the source can be maintained at a high level regardless of what happens in the cycle itself.

Feedwater heaters

In order to solve problems relating to the regenerative cycle, it is necessary to determine the quantities of steam extracted by making an energy balance for the heaters. Two types of heaters are in general use — the open heater, in which the extracted steam and the feedwater returning to the boiler are mixed and emerge as a single stream; and the closed heater, in which the steam and feedwater are kept separate. Heat is transferred through the tubes in the second type. Fig. 5 illustrates the two types of heaters.

Following the notation of Fig. 5 (a), the energy balance for the open heater is written

$$x h_d + (1-x)(h_j - h_k) = 0.$$

Neglecting potential and kinetic energy differences, note that $\Delta h = O$ since $Q = O$ and $W = O$. Solving for x, we get

$$x = \frac{h_k - h_j}{h_d - h_j}$$

Referring to Fig. 5 (b), h_d is the enthalpy of steam extracted from the turbine, h_k is the enthalpy of saturated liquid water at the extraction pressure and h_j is the enthalpy of saturated liquid water at the pressure of the next extraction point plus the enthalpy rise due to pump work from i to j. If the pressure and temperatures are sufficiently low that water can be considered as being practically incompressible, the enthalpy increase due to pumping from i to j is

$$\Delta h = W_{pump} = \frac{v \Delta p}{\text{eff}_p},$$

where the pump efficiency, eff_p, is defined as the ratio of the enthalpy rise for an isentropic pumping process to the actual enthalpy rise.

When compressibility is significant, the properties of compressed liquid water given in the steam tables should be used.

Energy balance for closed heater

For the closed heater shown in Fig. 5 (b), the energy balance is

$$y h_e + (1-x-y)\, h_h - (1-x)\, h_i + W_{pump} = O$$

Solving for y, we get

$$y = \frac{(1-x)(h_i - h_h) - W_{pump}}{h_e - h_h}$$

The value of x will be known from the energy balance made for the preceding (open) heater. The enthalpy h_h is found in the same manner as the enthalpy h_j. If the heater is perfect, h_i will be equal to the enthalpy of saturated liquid water corresponding to the extraction pressure at e. The pump work depends on the physical arrangement of the heater and the related piping.

The temperature of the feedwater leaving the heater at i' is always less than the saturation temperature corresponding to the pressure at e, the difference being known as the *terminal temperature difference* for the heater. Therefore, an energy balance is necessary at the point where the feedwater and drips from the heater are mixed in order to determine the value of h_i. Fortunately, the terminal difference is known, or can be estimated, so this energy balance can be made without first making an energy balance for the heater (which requires knowing the value of h_i).

EXAMPLE 1. Reheat cycle includes one stage of feedwater heating. Steam for feedwater heating is

withdrawn from the turbine at a temperature of 270 F. Determine the thermal efficiency and the ratio of expansion work to pump work when (a) all processes are reversible and (b) when the internal engine efficiency of the turbine and pumps are 0.80 and 0.92 respectively, and the terminal temperature difference for the feedwater is 6 F.

Referring to Fig. 6, the steam tables and the preceding examples, we find

(a) $s_i = s_f = 1.5323$ Btu/lb

$T_i = 270$ F

$$x_i = \frac{1.5323 - 0.3958}{1.2769} = 0.890$$

$h_i = 1{,}170.6 - (1 - 0.890)\ (931.8)$
$= 1068.0$ Btu/lb

$p_i = p_j = p_a = 41.86$ psia

$$(W_{pump})_{h\text{-}a} = \frac{v_h\ (p_a - p_h) \times 144}{778}$$

$$= \frac{0.01604\ (41.86 - 0.2563) \times 144}{778}$$

$= 0.1237$ Btu/lb

$h_a = h_h + (W_{pump})_{h\text{-}a}$
$= 28.06 + 0.1237$
$= 28.18$ Btu/lb

$p_k = p_b = 600$ psia

$v_j = 0.01717$ cu ft/lb

$$(W_{pump})_{j\text{-}k} = \frac{v_j\ (p_b - p_j) \times 144}{778}$$

$$= \frac{0.01717\ (600 - 41.858) \times 144}{778}$$

$= 1.774$ Btu/lb

$h_j = 238.84$ Btu/lb

$h_k = h_j + (W_{pump})_{j\text{-}k}$
$= 238.84 + 1.774 = 240.61$ Btu/lb

$$w = \frac{h_j - h_a}{h_i - h_a} = \frac{238.84 - 28.19}{1068.0 - 28.19} = 0.202$$

$W_{pump} = (1 - w)\ (h_a - h_h) + (h_k - h_j)$
$= (1 - 0.202)\ (0.1237) + 1.774$
$= 2.76$ Btu/lb

$W_{turb} = (h_d - h_e) + (h_f - h_i) + (1 - w)\ (h_i - h_g)$
$= (1289.9 - 1188.3) + (1322.1 - 1068.0) + (1 - 0.202)\ (1068.0 - 871)$
$= 512.7$ Btu/lb

The work ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{512.7}{2.76} = 186$$

$Q_A = (h_d - h_k) + (h_f - h_e)$
$= (1289.9 - 240.61) + (1322.1 - 1188.3)$
$= 1183.1$ Btu/lb

$$Eff_{th} = \frac{W_{turb} - W_{pump}}{Q_A} = \frac{512.7 - 2.76}{1183.1}$$

$= 43.1\%$

(b) Taking the turbine and pump efficiencies $eff_{et} = 0.80$ and $eff_{ep} = 0.92$, into account we find (feedwater heater TTD = 6 degrees F)

$h_i = h_f - eff_{et}\ (h_f - h_i)$
$= 1322.1 - 0.80\ (254.1)$
$= 1118.8$ Btu/lb

$T_i = 270$ F $\quad p_i = 41.86$ psia

$$h_a' = h_h + \frac{1}{eff_{ep}}(h_a - h_h)$$

$$= 28.06 + \frac{1}{0.92}(0.1237)$$

$= 28.19$ Btu/lb

$T_i = 270 - 6 = 264$F

$h_i = 232.7$ Btu/lb $\quad p_i = 41.86$ psia

$v_i = 0.01712$ cu ft/lb $\quad p_m = 600$ psia

$$(W_{pump})_{i\text{-}m} = \frac{v_i\ (p_m - p_i) \times 144}{778}$$

$$= \frac{0.01712\ (600 - 41.858) \times 144}{778}$$

$= 1.77$ Btu/lb

$h_m = h_i + (W_{pump})_{i\text{-}m} = 232.72 + 1.77$
$= 234.49$ Btu/lb

$$h_m' = h_i + \frac{1}{eff_{ep}}(h_m - h_i) = 232.72 + \frac{1}{0.92}(1.77)$$

$= 234.64$ Btu/lb

$$w = \frac{h_i - h_a'}{h_i' - h_a'} = \frac{232.72 - 28.19}{1118.8 - 28.19}$$

$= 0.187$

$W_{pump} = (1 - w)\ (h_a' - h_h) + (h_m' - h_i)$
$= (1 - 0.187)\ (0.13) + 1.92$
$= 2.025$ Btu/lb

$W_{turb} = (h_d - h_e') + (h_f - h_i') + (1 - w)\ (h_i' - h_g')$
$= (1289.9 - 1200.4) + (1322.1 - 1118.8) + (1 - 0.187)\ (1118.8 - 925.8)$
$= 449.7$ Btu/lb

The work ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{449.7}{2.025} = 223$$

$Q_A = (h_d - h_m') + (h_f - h_e')$
$= (1289.9 - 234.64) + (1322.1 - 1200.4)$
$= 1177.0$ Btu/lb

$$Eff_{th} = \frac{W_{turb} - W_{pump}}{Q_A} = \frac{456.2 - 2.025}{1177.0}$$

$= 38.6\%$

A table of comparative values shows the full significance of the modifications made in steam power cycles from the Carnot cycle up to and including the modern cycle incorporating superheat, reheat, and feedwater heating. These values were obtained from the examples already calculated.

Cycles	$\frac{W_{turb}}{W_{pump}}$	Eff_{th}
Ideal Carnot	2.44	51%
Irreversible Carnot	1.17	13%
Ideal Rankine	103.5	42%
Irreversible Rankine	76	33%
Ideal superheat	278	39%*
Irreversible superheat	204	32%
Ideal reheat and superheat	311	4%
Irreversible reheat and superheat	229	32%
Ideal reheat, superheat and feedwater heating	186	43%
Irreversible reheat superheat, and feedwater heating	223	39%

*Pressure limit changes

Next month: The last article in INDUSTRY & POWER'S Thermodynamics Refresher. Prof. Lee will discuss "How to compute steam power plant heat balances."

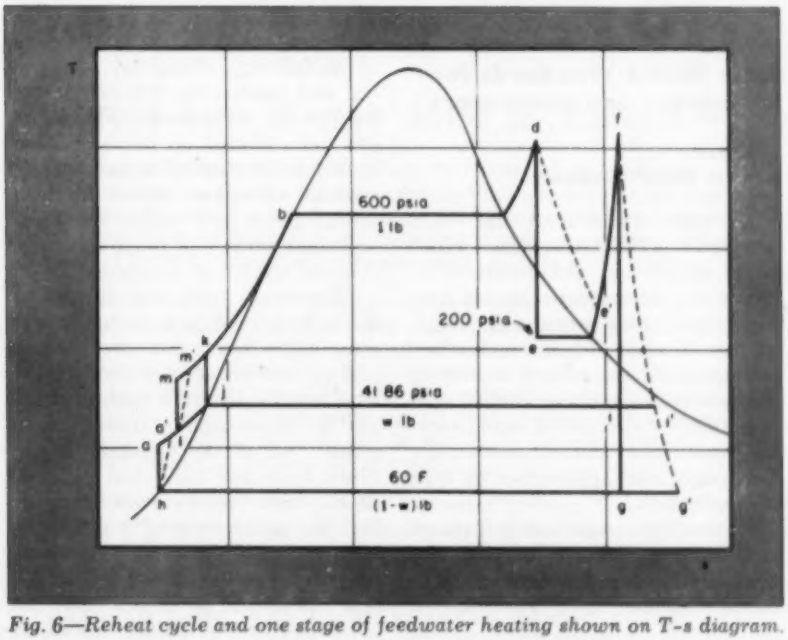


Fig. 6—Reheat cycle and one stage of feedwater heating shown on T-s diagram.

In brief . . . .

AIEE Fall General Meeting

THE AIEE held its Fall General meeting in Chicago this month. Here are highlights from papers of interest to INDUSTRY & POWER readers that were presented at Chicago.

Aluminum-sheathed control cable

E. E. McIveen
Okonite Company

"Aluminum-sheathed control cable need be considered unique only in respect to the sheath material, but the gain in mechanical ruggedness over the ordinary lead-covered or nonmetallic finished cables is so pronounced that it is clear there is no need to protect it with conduit or additional armor.

"To illustrate this and other attributes quantitatively, it would be well to select a specific type of cable. If the choice falls on a relatively new high-temperature insulation of the silicone rubber family, it would serve a dual purpose, for this class of insulation has been considered in some quarters as more tender than hitherto acceptable for pulling into conduits.

"To digress for a moment, it might be noted that to make steam plants more efficient for electric power generation, engineers have been increasing boiler temperatures and pressures. This trend has reached the point where auxiliary equipment in the immediate area must be able to operate at ambients considerably above those formerly used. Not only has this created a need for a practical, high-temperature electric system, but has also increased the extent and importance of this system because of the necessity of elaborate controls.

"In addition to power plants and prime movers, many industrial manufacturing processes are also concerned with these high ambients as well as process vapors. Not only have the usual rubber insulations deteriorated in this service, but conduit systems have a propensity for collecting moisture and deleterious chemicals and this has aggravated the situation. The silicone rubber-insulated, aluminum-sheathed cable provides a practical solution to this problem. . . .

"Drawn-down aluminum-sheaths can be applied over almost any insulation, and they could gain utilization for both exposed and enclosed work in dry locations, as well as where exposed to the weather, liquids, chemicals, vapors, or fumes which are not injurious to unprotected aluminum. Where exposed to destructive corrosive conditions, the sheaths should be protected by coatings or coverings suitable for these conditions. . . .

"Aluminum - sheathed cable should find wide application in generating stations, oil refineries, chemical plants, paper mills, steel mills, and industrial and commercial establishments in general."

New NEMA standards for dc motors and generators

J. F. Davis
General Electric Company

"A new definition has been adopted as a NEMA standard which reads as follows: 'An industrial dc motor is a dc dripproof motor having a continuous rating and designed, listed, and offered in standard ratings with standard operating characteristics and mechanical construction for use under usual service conditions without restriction to a particular application or type of application.'

"One of the significant features of this definition is that it specifies the dripproof enclosure as compared with the 'open' enclosure of the general-purpose motor definition. The surveys indicated that at least a dripproof enclosure was required in a high percentage of applications in order to help adequately protect dc machines, particularly their commutators, when located in the average factory environment. The previous standards recognized dripproof dc machines as an alternative with higher temperature rises than open machines and with no service factors applying to their ratings. Therefore, the new standards provide better protection while still retaining the service factor of the general-purpose motor."

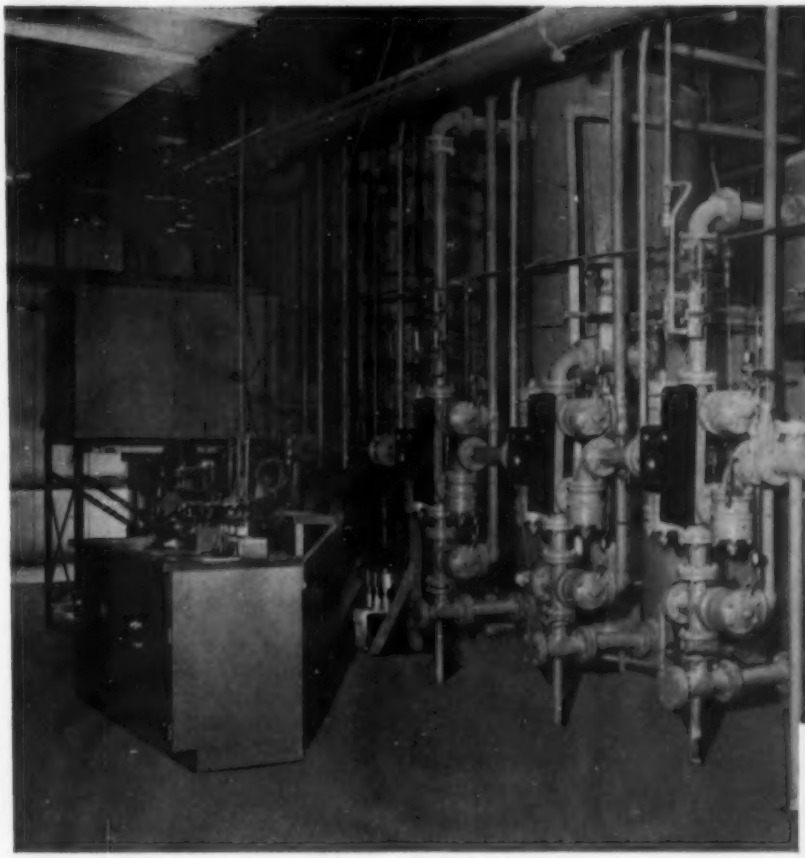
Integrated steam station protection

AIEE Working Group
On Steam Station Protection

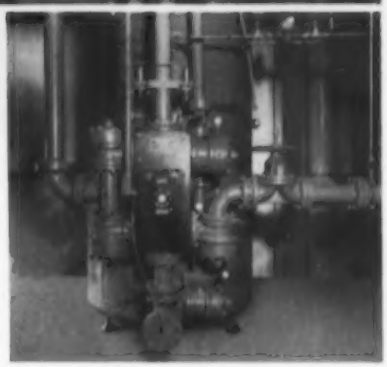
"To convert fuel to electrical energy in the most economical manner, the various elements within the steam power plant (boiler, turbine, generator, and auxiliaries) must take advantage of the latest technological advances in the fields of metallurgy, chemistry, electricity, and mechanics. Within the last few years, considerable discussion has been offered on these developments as they affect separately the various elements within a steam power plant and enable the trend to larger units and more advanced thermal cycles to continue.

"However, with the advent of these larger boilers, turbines, and generators has come the philosophy of unit connection and centralized control wherein each machine and its accessories is treated as an entity. All of the elements in the plant from the coal yard right up to the high-voltage switchyard affect the production of a particular steam plant. With this vast area under the surveillance of only a few operators, it is felt that the combined protection and interlock-

INFILCO improved demineralization reduces feedwater costs 35%!



INFILCO Demineralization Plant installed at the North Omaha Station.



Close-up of "CATEXER" ion exchange unit.

Here's how it was done at Omaha –

Omaha Public Power District's source of feedwater make-up for 1500 p.s.i. boilers is the Missouri River. This water has high and extremely variable mineral content. Their previous experiences with two-bed demineralization plants indicated that the average chemical cost per 1,000 gallons of treated water would be approximately 40¢.

In considering the water treating requirements of the new North Omaha Station, INFILCO Engineers suggested a new type, four-bed demineralization plant. This suggestion was accepted and actual operations have shown the chemical costs have averaged 26¢ per 1,000 gallons—a saving of 14¢ over the original estimates. In addition, this *fully-automatic* plant initiates regeneration when required, regardless of variations in raw water mineral content, without sacrificing treated water quality.

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AIEE Fall General Meeting

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ing of each element within the plant which provides overall plant protection should be given close scrutiny and considerable study."

"In modern unit-connected plants, an error not properly cleared could jeopardize a large amount of expensive equipment or delay restoration of considerable output. This requires that a predetermined sequence of starting and stopping each unit be followed, and that protective devices and interlocks be provided to assure satisfactory and safe performance under normal as well as emergency conditions. The system and plant operating practices and protection schemes must be considered and the whole integrated into a common framework. Since many of the protective devices and interlocks are electrical in nature, the job of interlocking various devices to provide automatic steam station protection usually falls upon the electrical engineer. . . .

"For these reasons, the AIEE Committee on Power Generation has formed a Working Group on Steam Station Protection to investigate current protective schemes used within electric utility steam stations. This working group was charged with the responsibility of investigating interlocks from the viewpoint of protecting equipment, limiting travel, interlocking operations to orderly procedures and the protection of areas and personnel. These interlocks were to be investigated as applied by the engineer throughout the steam station . . .

"This subject of steam plant protection is extensive and complex and yet, to date, few of the philosophies behind present practices have been thoroughly examined. Like any control scheme, the protection within the plant is subject to the personalities of those working on that particular scheme, to past practices, and to existing devices. Therefore, it was felt that a service could be rendered to the members of the Institute if this working group could approach and analyze the current protective schemes used in steam plants so that the basic philosophies beneath various plant protection schemes could be summarized in a report. This would enable the electrical control designer to obtain the necessary overall picture so that he could recognize the importance of each situation. At the same time, it is hoped such a report could eliminate much of the complication presently found."

Problems in motor protection

O. A. Lentz
T. Niessink
Commonwealth Associates, Inc.

"Comprehensive motor protection would consist of devices which could detect various types of phase and ground faults in the motor, locked rotor and overload conditions, single-phase operation, improper operating voltage, and reverse-phase sequence. The amount of equipment to be used to detect any or all of the above conditions in a practical application is dependent upon a comparison of the resulting damage to the motor, interruption of service and production, and available protective equipment versus economics. . . .

"[The authors conclude:]

"1. Availability of data on motor damage characteristics is rather limited and shows wide variations.

"2. Reliable data on the motor damage and protective device curves are required to obtain proper motor protection. Because of the wide variations in both of these characteristics, special care in application is required to obtain best results.

"3. Some standardization in motor damage characteristics would reduce the problem of developing and applying devices for motor protection.

"4. If the trend is to design motors with lower thermal abilities, the problem of obtaining selectivity between the protective device and motor damage curve will become more acute.

"5. The development and application of thermal protective devices for overload protection should take into consideration the different dissipation heat rates of the motor and the protective device and the different ambient temperatures at the thermal device and motor locations.

"6. The settings required on some instantaneous and quick-acting protective devices to be inoperative on transient inrush currents are undesirable since they result in a sacrifice of circuit and motor short circuit protection.

"7. Any undervoltage device should have time delay to avoid unnecessary tripping on voltage disturbances."

Economic selection of auxiliary drive motors

E. T. B. Gross
V. F. Bobrowicz
Illinois Institute of Technology

"[Our] economic study has been based on consideration of the thermal characteristics of the motors. It is realized that the torque requirements may sometimes be the determining factor in motor selection. The reduction in nameplate rating of the motor carries with it corresponding reductions in locked rotor torque and breakdown torque. Since stations are designed on the basis of certain assumed low-voltage conditions, it is important that these be rechecked to be sure that during system trouble or bus transfer, the motors will not stall or fail to start. . . .

"For example, the 2000-hp boiler feed pump motor originally chosen has a breakdown torque of 200 percent of this nameplate rating. With the suggested motor rating of 1250 hp, the value would become 143 percent of the bhp requirements of 1750 hp. The voltage dip that could be tolerated would fall from 30 percent to 16 percent. To obtain increased torque in the lower nameplate rating motor would add to the cost. In the case of pulverizer mills, the locked rotor torque might be the deciding factor . . . .

(continued on page 72)

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"Certain general conclusions may be stated:

"1. The use of conservative or rule-of-thumb methods in the application of drive motors for the auxiliaries in a steam power plant may lead to uneconomically large margins between the maximum design requirements of the auxiliaries and the drive motor ratings.

"2. The maximum design brake horsepower of the pumps and fans includes some margin above the expected full-load requirements. This may lead to large differences between motor output and motor ratings after the power plant is in operation.

"3. By applying smaller motors and by taking advantage of the service factors available, certain economies may be effected. These savings are realizable because of the lower initial cost of the motor and appear to be independent of assumed motor life. Also, in many cases, the saving in cost of power consumed by the motor may be significant if a smaller motor could be operated at a higher percentage of its rating and hence at a higher efficiency.

"4. Use of an insulation class which permits a greater maximum thermal rating on a specific motor may be advantageous in some applications. This is especially true where the starting torque required by the load is low in comparison to full-load torque, such as for a centrifugal boiler feed pump.

"5. The potential saving which may be realized will in most cases justify a detailed analysis of the drive motors to be applied.

"6. The economies may be realized at no apparent decrease in reliability of the power plant, although operating a motor at a higher percent of rated load or at occasional overloads may shorten its useful service life.

"7. In any motor application study, it is necessary to know the characteristics of the load in detail in order to avoid possible duplication of margins.

"8. Higher overall plant efficiency will be the final result of detailed analyses of drive motor applications."

Surge protection on industrial systems

C. L. Wagner
Westinghouse Electric Corporation

"The rapid expansion of industrial plant distribution systems in recent years has caused many new problems for the plant design engineer. It has also accentuated certain problems that in the past caused little concern. Surge protection for the plant system is one of these latter problems.

"In the past, the philosophy behind surge protection was primarily to prevent damage to the electrical equipment itself and thereby keep the repair costs for this equipment to a minimum. With this philosophy, not too much emphasis was placed on surge protection by the overall plant designers. In recent years, however, continuity of service has become a paramount concern.

"Now the breakdown of a piece of equipment means not only repair or replacement expense, but more importantly, loss of production for that portion of the plant effected by the breakdown. In many cases, primarily in the chemical industry, it could mean the complete shutdown of the plant due to the interruption of a critical processing operation. Small wonder that more and more emphasis is being placed on surge protection by plant designers. . . .

"The science of surge protection is one of 'prevention plus control.' The first step to be taken by the plant designer is to attempt to prevent the occurrence of surges on his system. This might take the form of shielding of his lines and stations to minimize the probabilities of lightning strokes to his system. It might also take the form of proper grounding to prevent the establishment of excessive transient voltages.

"The second step is to provide a means of controlling the surges that slipped by the preventive schemes. This may take the form of lightning arresters, surge capacitors, or any other equipment necessary to prevent damage to the apparatus on the system. Both steps must be taken to provide the maximum in protection for the plant system.

"Protection of the industrial plant system against damage due to switching surges and other transient voltages is in many cases more critical than protection against lightning surges. When the control step of the 'prevention plus control' program of surge protection is attempted, certain difficulties immediately arise. In the first place, the switching surge strength of electrical apparatus has not been definitely established. The frequencies involved in these switching surges vary between 1000 and 2000 cycles. Thus the apparatus insulation strength for these surges probably lies somewhere between the 60-cycle and the impulse insulation levels. At the present time, it is not known exactly what this value is, however. The same difficulty arises with the lightning arresters. There is not sufficient data on arresters at this switching surge frequency to determine what protective characteristics they possess. A considerable amount of work is being done by the industry at the present time in an attempt to establish these values."

Aluminum windings for dry-type transformers

E. W. Tipton
Westinghouse Electric Corporation

"So far as transformers are concerned, dry-type power transformers offered certain advantages in the use of aluminum windings. The lower conductivity of aluminum results in larger coils and a bigger core. In a liquid-filled transformer it may call for more insulation, more oil, and a larger and more expensive tank. The case of a dry-type transformer is of a simple lightweight construction and its size is frequently determined by the size of steel-clad switchgear with which

dry-type power center transformers are coordinated in appearance. A somewhat larger core and coil structure does not add greatly to the cost of the case.

"Dry-type power transformers use Class B insulation and a minimum of solid insulating materials. The principal insulator is air. Consequently, a small increase in the size of the core and coils only slightly increases the cost of insulation. One other consideration is that dry-type transformers are installed indoors. This eliminates one of the more serious problems in the use of aluminum windings because in such applications there are no aluminum-to-aluminum or aluminum-to-copper connections which are subjected to the moisture of outdoor weather. . . .

"While the manufacturing and design problems were satisfactorily solved, the aluminum-wound transformer did not prove economical. . . . Cost of the core and coil structure proved to be 33 percent higher than cost of the equivalent copper-wound transformer. Two-thirds of the cost difference was due to the cost of the glass-insulated aluminum strap which, at the time, cost 2.76 times as much per pound as copper. Most of this additional cost was in the drawing and covering of the wire since the aluminum wire bar costs were only 1.13 times as great as copper costs. . . .

"[The author concludes:]

"1. The technical problems incident to the successful design and manufacture of small- and moderate-sized dry-type transformers [have been] successfully solved.

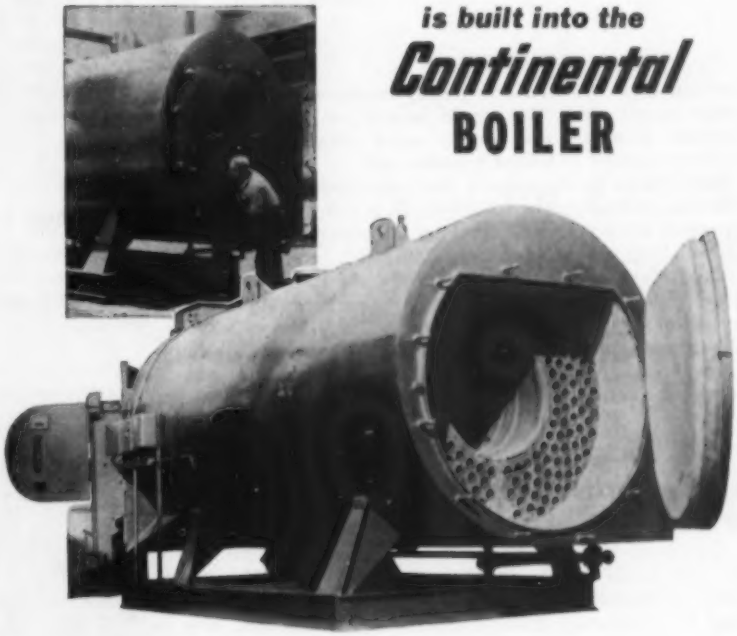
"2. Over a hundred transformers up to 3000 kva in size were built in a time of copper shortage, releasing a considerable quantity of copper for other transformers.

"3. These transformers have been in service from three to four years with no difficulty of any kind.

"4. Cost of an aluminum-wound transformer was one-third higher than the equivalent copper one. In the period since these units were built, the processing cost of aluminum conductors has been reduced — but not enough to make it economical at the present time.

"5. More work is needed on methods of joining aluminum to speed up the manufacturing processes and to reduce the joining costs."

ACCESSIBILITY



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ideas in action

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necting their systems and jointly constructing a larger, single power plant. This would be less costly to build and operate. It would also supply more reliable service to both companies at lowest possible cost.

New steam power station was constructed by Stone & Webster at Marquette, Michigan. It is jointly owned and operated on a nonprofit basis by the newly incorporated Upper Peninsula Generating Company. Initial installation consists of a 22,000-kw preferred standard turbogenerator, and a 220,000-pound/hour steam generating unit, operating at 850 psi and 900 F on coal firing. Power leaves the step-up substation at 69 kv and is delivered to both the Iron Company and the Power Company. The two networks are connected by a 100-mile transmission line.

Larger horizontal collectors provide more water

Two large horizontal collectors are providing 5000 gpm of clean water for the Steubenville mill of the Wheeling Steel Corporation, Ranney Method engineers decided that an infiltration gallery, approximately 900 feet long, would yield the required supply. A 20-foot diameter, reinforced-concrete caisson was lowered through sand and gravel to bedrock at the edge of the pool stage of the Ohio River. Caisson bottom was sealed with a watertight concrete plug and the shaft was dewatered. Twenty-four-inch diameter horizontal laterals were projected through steel port castings grouted into the bottom section of the caisson. Four hydraulic piston jacks actuated the jacking cradle with a total capacity of 400 tons. The first lateral was projected to a length of 408 feet in a direction downstream and angling offshore. The second lateral was similarly projected to a length of 448 feet upstream. Projection of all laterals was completed in two months.

Although the top of the caisson will be nearly 14 feet below the 1936 high-water level of the river, the unit is designed so that it can be submerged without damage. Seventy-one hour's pumping at an average rate of 6500 gpm showed a drawdown of 15.89 feet — slightly more than one half of the total available drawdown. This technique does not disturb the actual river bed. This is important, since most of the purification takes place as the water permeates through the first few inches of river bed and into the lower sand and gravel.

Touchup paint in cans with built-in stirrer

Coastal-finish transformer paint is now being packed in convenient spray cans. They contain small agitator balls that help stir the paint when vigorously shaken. Westinghouse Electric Corporation's system uses three coats to make up the complete finish. This is a simple way to touch up transformers and other hard-to-reach spots.

Cans are hermetically sealed and can be stored for years if they are kept out of direct sunlight and in temperatures

below 120 F. Three-coat system consists of prime coat for good adhesion and chemical resistance to salts, acids, and alkalies; an intermediate coat of modified phenolic and alkyd resins that are resistant to heat, oxygen, salts, acids, and alkalies; and a third coat that is standard gray finish made of resins and pigments chosen to withstand the elements and give good appearance. Pigment contains mica flakes that overlay in the film to form a "shingled-roof" effect, which repels water and increases heat stability.

Temperature and humidity control deluxe

Rooms in which temperature can be controlled over a 120-degree range to within ½ degree and in which humidity can be adjusted within three percent are being built by the General Electric Company at its huge Appliance Park. Rooms will be used for testing household refrigerators and freezers. Close tolerances of temperature and humidity are possible through the use of special equipment designed and built by General Electric engineers and use of Fiberglas insulation installed by the drywall construction method. Insulation helps stabilize test

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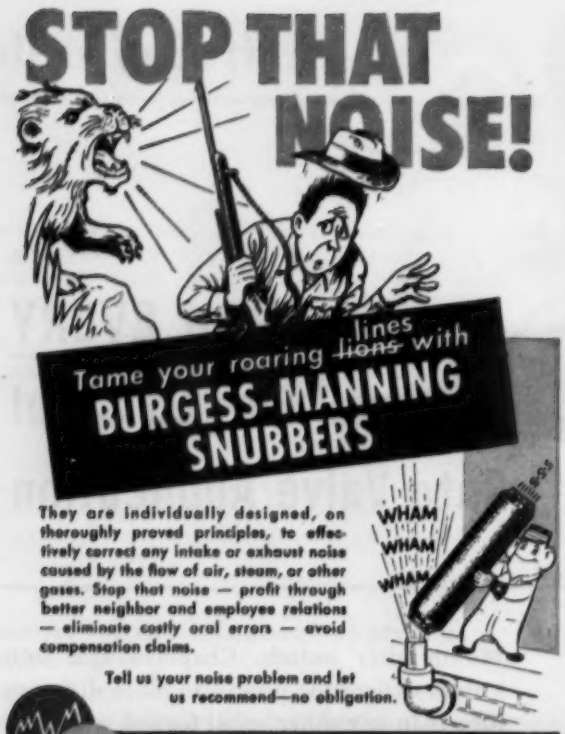
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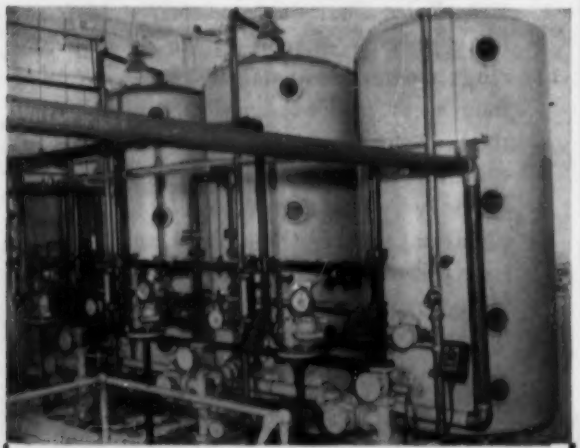

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conditions and prevents condensation on exterior surfaces of cold rooms. It reduces heat transfer and prevents abnormal loads on conditioning equipment.

Different types of vapor barriers are used for the dry rooms (in which low temperature tests are made) and for the wet rooms (in which conditions of high humidity and

heat are simulated). Stainless steel is the vapor barrier as well as the interior finish for the wet rooms. Aluminum foil is the barrier for the dry rooms. Atmospheres in the rooms can be controlled at temperatures from 1 F to 120 F (within one-half degree) and at humidities to 95 percent (within three percent).

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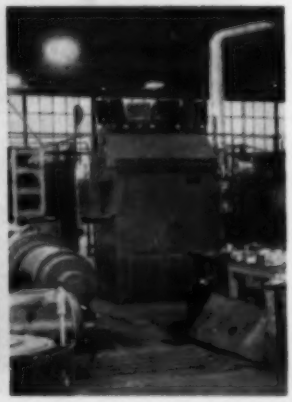

coming events

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Oct. 19-20	ASME Joint Fuels Conference	Neil House Columbus, Ohio
Oct. 27-28	National Conference Industrial Hydraulics	La Salle Hotel Chicago
Nov. 1-3	Fifth Industrial Electric Exposition	Wm. Penn Hotel Pittsburgh
Nov. 1-3	NACE Panel Conf. Underground Structure Corrosion	Hotel Niagara Falls Niagara Falls
Nov. 13-18	ASME Annual Meeting	Congress Hotel Chicago
Nov. 14-17	Second International Automation Exposition and Exhibition	Navy Pier Chicago
Nov. 14-18	Exposition of Power and Mechanical Engineering	Coliseum Chicago
Nov. 27-30	American Institute of Chemical Engineers Regular Annual Meeting	Statler Hotel Detroit
Nov. 28-Dec. 1	Air Conditioning and Refrigeration Exposition.	Auditorium Atlantic City
Dec. 12-17	AIChE Nuclear Congress & Atomic Exposition	Municipal Auditorium Cleveland
	1956	
Jan. 30-Feb. 3	AIEE Winter General Meeting	Hotel Statler New York

coming next month in

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water ideas you can use!

Details of an up-to-the-minute automatic control system for a modern mixed-bed demineralizing system will show you the way to improved water supply for your own needs. Read about the setup at Shawville Station of Pennsylvania Electric and pick up pointers that will help you. You will learn how raw water of greatly varying character is made usable for all the services needed in this 250-mw plant. The complete story of this fully automatic system incorporating the last word in control panels will be in

the November issue of

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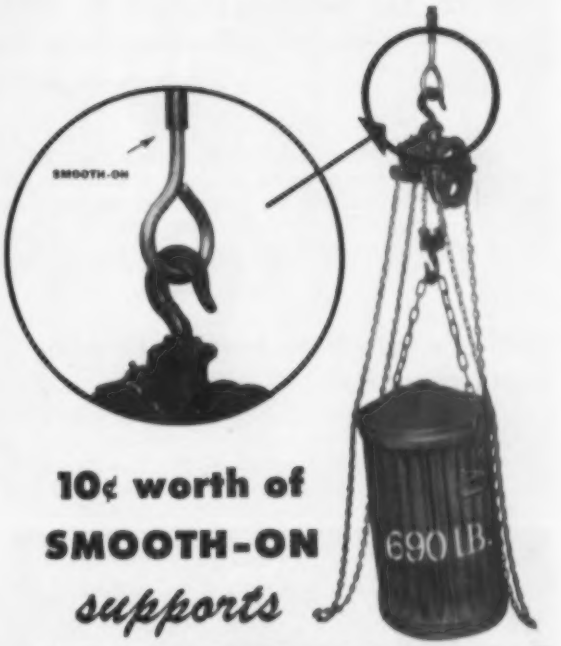

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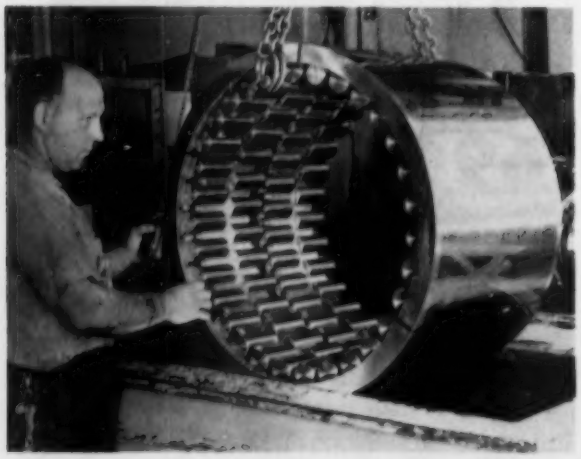
full-time to look after the stoves 24 hours a day. The new Dravo heaters automatically provide a uniform comfortable heat throughout the plant. They also save 4000 square feet of valuable floor space that was formerly occupied by stoves and coal bins.

Multirow cylindrical bearings invade nonferrous fields

Largest multirow cylindrical bearings ever built will be installed in Kaiser's new multimillion-dollar sheet and foil rolling mill in Ravenswood, W. Va. Bearings have a 34½-inch outside diameter with a 24⅝-inch bore and a



width of 25⅛ inches. Bearings have given long trouble-free performance at high speed in both steel-mill and nonferrous applications without costly circulating lubricating systems and with minimum maintenance.

Fireproof plastic panels for windows

First Fiberglas-reinforced daylighting panels to be approved by Underwriters' Laboratories, Inc., have been installed in the storage warehouse of the Goodyear Tire

& Rubber Company. Fire-Snuf panels, manufactured by the Resolite Corporation, have a flame-spread rating below 75. By comparison, the rating for plastic wall tile is 170, and for cellulose board it is 255. The panels are self-extinguishing and will not support combustion. They are molded of Fiberglas and Hetron, a permanently self-extinguishing polyester resin manufactured by Hooker Electrochemical Company. Panels are shatterproof and have high strength, stability, and load-bearing characteristics.

Boilers burn dust and save dollars

Savings of $13,000 per year are just one of the benefits Rowe Manufacturing Company, Galesburg, Illinois is reaping from its dust control system. Rowe operates more than 100 woodworking machines, which produce several tons of wood dust daily. Dust is collected by hoods at each machine, is sucked into two ducts, and is blown into a centrifugal and a Pangborn CM collector. System has increased production by eliminating dust nuisance in the plant, and has greatly improved both employee and community relations.

Dust is burned to supply steam for power and processing. Substituting waste wood dust for the oil that formerly was burned saves Rowe $10,000 during the winter months

and a minimum of $100 per week during the warmer months. Dust is collected and stored in a bin holding two to three carloads. It's fed pneumatically at a slow rate direct to the boiler. Rotary valve system prevents flarebacks from reaching the storage bin. During the winter months, additional scrap is fed to a "hog" for grinding, and is fed through the collection system to the boiler.

Continuous cooling stops well-water wastage

Recirculating continuous-cooling system saves 115,000 gallons of private well water per day at the processing plant of Norwich Pharmacal Co., Norwich, N. Y. A Dem-

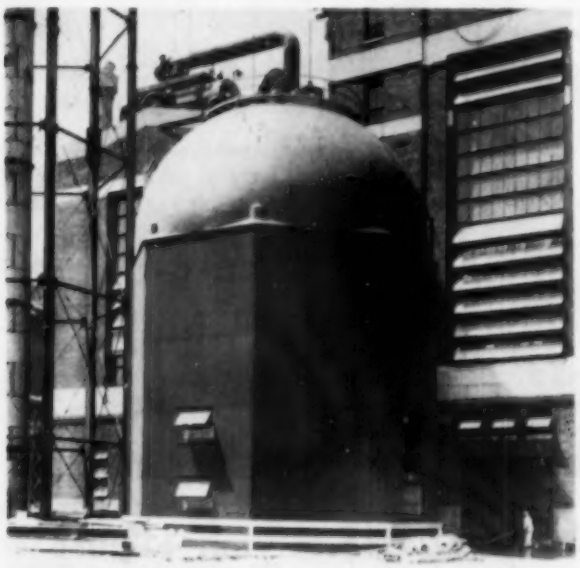
ideas in action

. . . starts on page 30

ing side-suction centrifugal pump rapidly pumps fresh water from a fresh-water supply tank through the cooling lines to the processing equipment. Water returns to the tank with only a slight temperature rise. Self-acting temperature flow valve opens a tap that supplies fresh cool water to the tank to maintain required water temperature. Water empties from tank through an overflow until the temperature flow valve closes the tap. Previous cooling system used 90 gpm of fresh well water. Now, the tank overflows only 10 gpm.

Ford's feedwater capacity increased

Installation of a new 200,000-gallon/hour water treatment system at Ford Motor Company's Rouge Power House No. 1 has been completed. New system—which yields virtually zero-hardness water — was designed, en-

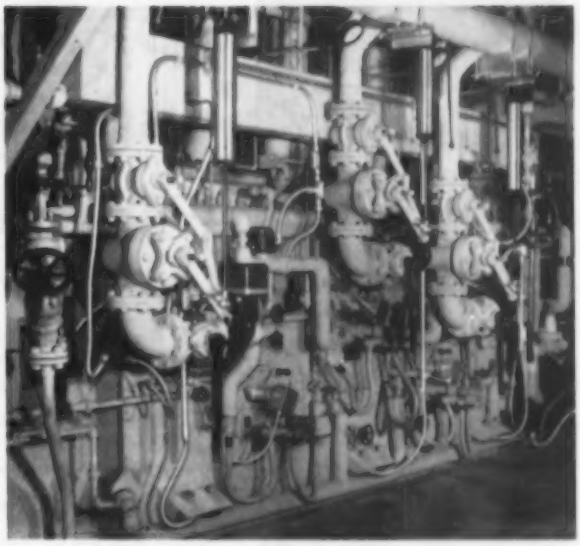


gineered, and installed by the Kuljian Corporation in collaboration with Ford engineers. Equipment includes a hot-lime softener (spheridome type), filters, hot-Zeolite softeners, a 1,600,000-pound/hour deaerating heater (thoroughfare type), and low-pressure boiler feed pumps. Supply of boiler feedwater was never interrupted during the installation.

Georgia Tech replaces muscles with air

Simultaneous hand-operation of two four-inch valves requires considerable force, even with the mechanical advantage of a long operating lever. Georgia Institute of Technology has installed Bellows Air Motors to do the "muscle work" at its modern power plant.

Operation of the valve levers also presented a serious safety hazard. Three dual-valve arrangements serve as master shutoff cocks in 2.5-psi natural-gas supply lines to



steam-generator burners. In each dual arrangement, the upper valve is a two-way type, used as a simple shutoff device. Lower unit is a three-way valve, located between the burner and the two-way cock. The two valves are mechanically interlocked to work together for safety.

When open, the three-way valve allows uninterrupted flow to the burner and its controls. In the closed position, its three-way construction allows gas that is trapped between shutoff cocks and burner to exhaust to atmosphere. Now, only a flick of the air-motor control lever is needed to operate the heavy valves.

Pulp grinders get largest motors ever

Six 6000-hp, 240-rpm, 4000-volt, synchronous motors, the largest ever applied to single pulp grinders, are being built for Bowaters Southern Paper Corporation by Electric Machinery Mfg. Company. The motors are en-

closed with air-to-water coolers located at the bottom. They have sleeve-type bearings that are 14 inches in diameter and 20 inches wide, lubricated by double oil rings. Each unit weighs 45 tons. The first motor has already been shipped for installation.

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handy guide

. . . to advertised products

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BUELL ENGINEERING COMPANY. Here's a dust collector that has proved effective on *natural* and *forced* draft installations. New descriptive folder gives complete design and performance data.

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More reliable air conditioning
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NIAGARA BLOWER COMPANY. This method of air conditioning is effective, easy on maintenance, and inexpensive to operate. For full information write for Bulletin 112, Department I.P.

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Built for accessibility
Read page 73 and circle number 103
Boiler Engineering and Supply Company, Inc. Continental Automatic Boiler offers simple, rugged design, with easy accessibility for good maintenance. Efficiency guaranteed. Bulletins BE3-4 give details.

For gauging all liquids
Read page 98 and circle number 104
The Liquidometer Corp. Liquids worth storing are worth measuring with a Liquidometer tank gauge. Completely automatic and U.L. approved.

Steam at the point of use
Read page 80 and circle number 105
Superior Combustion Industries Inc. Completely packaged Superior Steam Generators can be installed at the point of steam consumption. Can be installed and operating within 24 hours. Catalog 702 gives sizes and ranges.

Titusville handles the load
Read page 39 and circle number 106
The Titusville Iron Works Company. TICOTHERM steam generators offer flexibility and efficiency. Can be adapted for all processing and heating needs.

Union exceeds 80 percent efficiency
Read page 33 and circle number 107
Union Iron Works. Union type MH package steam generators offer proven performance in efficiency and economy. Bulletin MH-353 gives complete story with cutaway illustrations, tube layouts, and dimension tables.

Coming events

New equipment exhibits
Read page 93 and circle number 108
Chicago Exposition of Power & Mechanical Engineering. ASME 75th Anniversary. Put this on your must list. The Power Show, November 14-18 in Chicago.

Communications systems

Losing man hours?
Read page 71 and circle number 109
Automatic Electric Sales Corporation. Cut losses with instant communication. Install a P-A-X Business Telephone System in your plant. Write for an actual "on-the-job" case study.

Electrical distribution

You can avoid motor burn outs
Read page 35 and circle number 110
Heinemann Electric Co. Circuit Breakers offer positive protection against burnout. Not affected by temperature fluctuations. Don't use heat—use power. Bulletin 1410 shows how.

Tilting arc chutes
Read page 7 and circle number 111
I-T-E Circuit Breaker Company. Switchgear Division. Save inspection time and effort with new I-T-E tilting arc chutes. I-T-E will help you plan and engineer your switchgear requirements. Bulletin 7004C gives details.

Tested noise levels
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Sorgel Electric Co. Sorgel transformers are tested for efficiency, noise level, temperature rise and performance before installation. Sizes and types available for every purpose.

Cut costs and corners
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Sprague Electric Company. Correct your low power factor right at the source of waste. Write for free copy of cost-saving guide, "Power Factor Correction."

Electrical utilization

Immediate delivery
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Fuels and firing equipment

Fuels do make a difference

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CHESAPEAKE AND OHIO RAILWAY. There's a lot more to buying coal than considering the cost per ton. Want to solve your particular fuel requirements? Chesapeake and Ohio will be glad to help.

Petro for heating

Read page 23 and circle number 116

PETRO. These oil burners are proving to be the modern answer for heat requirements in huge apartment developments and manufacturing plants. Clip and mail the coupon for free catalog and information.

Dual stage burners

Read page 90 and circle number 117

NATIONAL AIROIL BURNER COMPANY, INC. New National Airoil Dual Stage Burner offers advantages of both steam and mechanical types of fuel oil atomization in one burner. Bulletin 25 gives detailed description, illustrations, and specifications.

Complete fuel requirements

Read page 14 and circle number 118

THE ENGINEER COMPANY. Enco fuel oil pump sets and heaters can take care of all plant requirements. Bulletin 0553 gives description of Enco's 10 important features.

Combustion economy

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THE ENOS COAL MINING COMPANY. Measure your coal cost in steam produced, not dollars per ton, and you will see why Enos can save you money. Place a trial order and compare.

Coal for every use

Read page 87 and circle number 120

GENERAL COAL COMPANY. A variety of anthracites and bituminous coals are offered by General. Branches in leading cities.

Instruments and controls

Temperature recording

Read page 94 and circle number 121

THE ELECTRIC AUTO-LITE COMPANY, INSTRUMENT AND GAUGE DIVISION. Model 1000 gives permanent temperature record. Available in various ranges and cycles. Remote reading optional. New Catalog.

Electronic controls

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EATON MANUFACTURING COMPANY, DYNAMATIC DIVISION. Automatic Speed Control or Dynamatic Electronic Controls now available with Dynamatic Eddy-Current equipment. Send for Dynamatic's Electronic Control bulletin, giving the story of modern industrial speed control.

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Measure your liquids

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Lubrication

Reduce breakdowns

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Pneumatic maintenance

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NEW YORK & NEW JERSEY LUBRICANT COMPANY. Grades of Non-Fluid Oil made specifically for pneumatic equipment. Send for Bulletin 550 and free test sample.

Maintenance items

Efficient piston packing

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DARLING VALVE & MANUFACTURING CO. Darcova Pumcups are standard piston packing for air and hydraulic mechanisms. Bulletin 4502 gives the facts: fewer shutdowns, lower costs, and longer life.

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Save on industrial track

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L. B. FOSTER CO. Use Foster relayers to install and maintain rails. Send for Catalog IP-10 to help you save on rails.

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GRAPHIC SYSTEMS. Boardmaster Visual Control gives graphic picture of your operations. Systemize your maintenance visually. Save time and money—prevent errors. Booklet P-10 tells how.

Support 690 pounds for 10 cents

Read page 77 and circle number 131

SMOOTH-ON MANUFACTURING CO. Smooth-On can do it. There are hundreds of uses for quick, low cost, emergency repairs. A free 48-page repair handbook is offered. Shows repairs in detail. Send to Dept. 19.

Solid steel collars

Read page 84 and circle number 132

STANDARD PRESSED STEEL CO., HALLOWELL POWER TRANSMISSION DIVISION. Solid steel collars that stay put are stocked in 42 sizes. Held on shaft by Unbrako Set Screws. Bulletin 868 describes complete stocks and uses.

Materials handling (bulk)

Industrial storage bins

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KALAMAZOO TANK AND SILO COMPANY. Industrial storage silos may be used for any flowable material. Vitrified glazed tile protects materials from weather, contamination, fire, and theft. No maintenance. Bulletin 1153-B shows advantages of silo storage.

Mechanical Power transmission

How to buy V-belts

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RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIVISION. Looking for extra strength and extra pulling power?—specify R/M Super-Power V-Belts. Get 40 percent more power capacity. R/M representative can show you how to get more use per dollar."

Piping, tubing, and hose

Unequalled for flexible service

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ATLANTIC METAL HOSE CO., INC. Atlantic has a flexible metal hose that is job tested and certified for every application. Catalog 500.

Pumping equipment

Ready return condensation units

Read page 89 and circle number 136

AMERICAN-MARSH PUMPS. Easy installation—just bolt down, connect lines and electricity. That's all. Redi-Return Bulletin 426 available. Write and describe your requirements.

A tradition of integrity

Read page 86 and circle number 137

AURORA PUMP DIVISION, THE NEW YORK AIR BRAKE COMPANY. Aurora's integrity stands behind its pump recommendations. Catalog "M" describes full line.

Nuclear pump leadership

Read page 100 and circle number 138

BYRON-JACKSON. Every company in the United States using nuclear reactors has consulted Byron Jackson for pump equipment. Write for special paper on pumps for nuclear power.

How to buy pumps

Read page 31 and circle number 139

DE LAVAL STEAM TURBINE COMPANY. A knowledge of design and how it affects performance can insure a good pump. Write to De Laval for Catalogs LS, and "Rotary Pumps."

Pumps for top fire protection

Read page 3 and circle number 140

WORTHINGTON CORPORATION, VERTICAL TURBINE PUMP DIVISION. Dependability is necessary for fire protection, and Worthington Vertical Turbine Fire Pumps are ready to supply water for sprinkler systems instantaneously. Bulletin W-450-B42 gives fire protection details for you.

Refractories and insulation

Castables save time and money

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UNIVERSAL ATLAS CEMENT COMPANY. Lumnite castables provide powerplant engineers with a fast, easy way to replace or repair linings. Write Lumnite Bureau for more information.

handy guide

. . . continued from preceding page

Traps, strainers, and separators

Engineered steam traps
Read page 28 and circle number 142
STRONG, CARLISLE & HAMMOND CO. Strong hydro-flex steam traps offer high efficiency under all condensate loads. Write for new Bulletin SS-40A.

What's maintenance?
Read page 40 and circle number 143
YARNALL-WARING COMPANY. No need for maintenance with Yarway Impulse Steam Traps. Want proof? Try it free for ninety days. Write for free trial or catalog.

Turbines

Operators prefer Coppus
Read page 25 and circle number 144
COPPUS ENGINEERING CORPORATION. Ask the man who has operated a Coppus steam turbine about its proven performance and design. Bulletin 135 tells you how to make your turbine dollars go farther.

Valves and regulators

Gate valve application
Read page 75 and circle number 145
THE CHAPMAN VALVE MANUFACTURING COMPANY. Chapman List-960 Valves can handle more types of jobs than any other small forged-steel gate valves. Catalog 10 lists specifications.

Blowoff safety
Read page 37 and circle number 146
EVERLASTING VALVE CO. Double boiler blowoff safety available with quick-operating, shock-resisting Everlasting valves. Bulletin describes ranges and sizes.

Vibration and noise control

Stop that noise!
Read page 76 and circle number 147
BURGESS-MANNING COMPANY. Burgess-Manning snubbers can correct your noise problems from air, steam, and other gas discharges. Let our sound engineers recommend solution. No obligation.

Water supply and treatment

Water treatment prescriptions
Read page 13 and circle number 148
W. H. & L. D. BETZ. If you have a water problem, let Betz prescribe treatment. A Betz district engineer will discuss your plant water problems without obligation.

"Jet Pump" action
Read page 99 and circle number 149
COCHRANE CORPORATION. Here is unbelievable efficiency in heat transfer. The Cochrane C-B System is guaranteed to get more heat from steam. Write for Publication 605.

Water troubles?
Read page 17 and circle number 150
DEARBORN CHEMICAL COMPANY. Complete water treatment service by Dearborn provides trouble-free water. Your Dearborn sales engineer will help you. Send coupon for bulletins available.

Demineralizer plants
Read page 76 and circle number 151
HUNGERFORD & TERRY, INC. All sizes and capacities of demineralizer plants are available, manual or automatic. Fully guaranteed. Write for details of this and other water conditioning systems.

Improved demineralization
Read page 69 and circle number 152
INFILCO, INC. Infilco engineers saved one company 14 cents per thousand gallons of treated water. Infilco can save money for you too. Write for information.

Quality controlled water
Read page 34 and circle number 153
L • A WATER SOFTENER COMPANY. L • A engineers are at your disposal to solve the requirements of your raw-water supply. Bulletin DM-4 gives details.

YOU CAN GET 42 STOCK SIZES 3/16" to 3"

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SOLID STEEL COLLARS from your industrial distributor

All of these precision-machined solid steel collars are size-marked for quick identification, and fitted with the famous self-locking UNBRAKO Socket Set Screw for positive positioning on the shaft. Write for Bulletin 868. STANDARD PRESSED STEEL CO., Jenkintown 39, Pa.

HALLOWELL POWER TRANSMISSION DIVISION SPS JENKINTOWN PENNSYLVANIA

Circle 132 on READ-N-CIRCLE card for more data

coming next month in

INDUSTRY & POWER . . . .

Chrysler licks a headache

Expansion and contraction of pipelines always causes problems. Chrysler Corporation engineers had their share in the steam lines at Highland Park Plant. But they licked the problem very neatly. You can lick your piping problems just as neatly. Let the Chrysler example help you. Read about it in

the November issue of

INDUSTRY & POWER

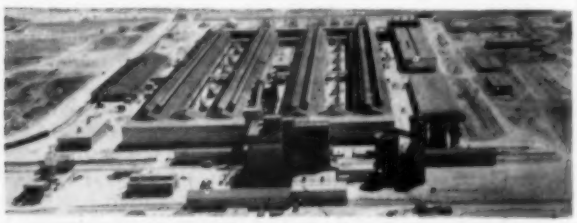
spot news

. . . . about industry & power

● New plants opening

Square D Company opened a new 112,000-square-foot plant in Cedar Rapids, Iowa. The building sits on a 54-acre site, and will employ 400 people. Square D will make circuit breakers, automation components, and voltage

testers at the new plant. In addition, the Cedar Rapids plant will serve as an assembly facility in the regional marketing of switchboards, lighting and power panels, and similar equipment.... Anaconda Aluminum Company formally opened a $65,000,000 primary aluminum



plant in Columbia Falls, Montana. Within a year, the new facility is expected to produce at the rate of 120,000,000 pounds per year.... Crane Packing Company is building on a new 17-acre site in Morton Grove, Illinois. Newest facilities are two buildings to house research and laboratory operation.... Harbison-Walker Refractories Company just opened a new plant at Leslie, Maryland to produce silica refractories. The plant is a 100,000-square-foot standardized steel structure built by the Luria Engineering Company.

● Company lineups continue to change

Byron Jackson Co. has become the Byron Jackson Division of Borg-Warner Corporation.... A formal contract is in preparation for the purchase of C. A. Olsen Manufacturing Company by Westinghouse Electric Corporation. Olsen is a producer of residential furnaces.... H. K. Porter Company has acquired a 13th division through the purchase of Electric Service Engineering Company, Joliet, Illinois. Eseco specializes in design and manufacture of complex electrical and electronic devices used in heavy industry.... Hewitt-Robins Incorporated plans to acquire the business, manufacturing facilities, and assets of the W. A. Jones Foundry and Machine Company, Chicago. The Jones line of heavy-duty speed reducers, pulleys, gears, and other accessories will augment the Hewitt-Robins line.... American Crucible Products Company, makers of bronze bearings, has acquired Kemco, Inc., Lorain, Ohio, producer of submersible pumps for sump and industrial application. . . . Trion, Inc., has sold its rights to the Dill dust-spot tester to the Research Appliance Company. Both firms are in the Pittsburgh area. The tester is a highly accurate instrument for measuring the efficiency of all types of air filters installed in ventilating systems.... Engineering and construction operations of The Fluor Corporation, Los Angeles, are being combined into one division in a major organizational change. Vice president and general manager for the new engineering and construction division at Fluor will be M. A. Ellsworth.

● More new plants on the way

Jones & Laughlin Steel have purchased a 31-acre industrial site in Willimantic, Connecticut for construction of a plant to produce cold-finished steel bars.... General Cable Corporation will construct a modern manufacturing plant in Tampa, Florida where it already operates a warehouse and sales office. The initial unit will contain 50,000 square feet on a 9-acre tract.... Dravo Corporation has broken ground for a $400,000 building to house applied industrial research activities. The Dravo Research Center will occupy a two-acre plot between the back channel of the Ohio River and Neville Road, adjacent to the company's main plant in Pittsburgh.... Tappan Stove Company is building a $300,000 addition to its Mansfield, Ohio plant.... Yale & Towne Manufacturing Company has purchased a new plant at Addison, Illinois for its Powdered Metal Products Division.

● Launch study of fan noise from air conditioning equipment

Development of a basic method of sound measurement that can be adopted as a standard for industry is the immediate objective of a program now starting by the Research Laboratory of the ASHAE. The program is endorsed by the National Association of Fan Manufacturers and the Industrial Unit Heater Association. In addition, the program will seek to determine attenuation of sound in ducts, and regeneration phenomena by turbulence in duct fittings and dampers.

● Safety makes news

Yale & Towne Manufacturing Company has been presented an Award of Merit from the National Safety Council for performance during 1954. Yale & Towne achieved a far lower accident frequency rate and severity rate than normal for kindred industries. Their frequency rate was 48 percent under similar industry averages, and their severity rate was 70 percent under average.... Otis Elevator Company has released figures showing that 2/3 of all elevator accidents reported from 1951 through 1953 applied to cars 20 or more years old. About 45 percent of serious and fatal accidents on elevators during the three-year period studied are directly traceable to lack of ade-

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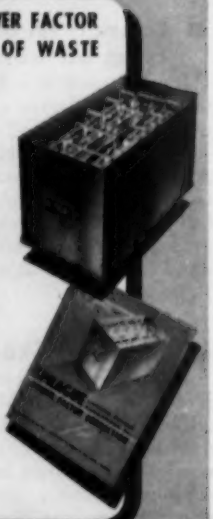

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spot news

. . . starts on page 85

quate and available safety devices. . . . The Bureau of Mines disclosed that twice as many men were killed in underground electrical accidents during the first seven months of this year as in the same period of 1954. The Bureau points out that proper precautionary measures are not being observed, nor is alertness being observed for unguarded trolley wires and exposed wiring at pumps, mining machinery, and in surface plants.

● Cleaner Air Week coming up

October 23 to 29 is Cleaner Air Week for 1955. The event is sponsored by the Air Pollution Control Association, and is intended to remind industry and the general public of the need for keeping air pollution at a minmum. It is also intended to point out the progress that has been accomplished in this field in recent years.

● Continuous processing trend spurs comeback of dc drives

Demand for dc drives is increasing as the result of the trend toward greater mechanization and more automatic production in industry. This reversal of the earlier trend away from dc drives results from the superior control of speed offered by the dc motor. General Electric cites figures that show that purchases of dc motors in the 1- to 200-hp range are up 85 percent since World War II, though sales of all motors within that power range are up but 20 percent. General Electric is coming out with an improved line of dc armored motors using Class H insulation. This is the first time that this insulation has been applied to the coils of dc motors in regular production.

● Prices go up and prices go down

General Electric Company has increased by 10 percent the price of rewinding and reconditioning all motors up to 500 horsepower. The boost was made because of increased copper and other material costs as well as higher operating overhead. On the other hand, the company has been able to reduce prices on its complete line of plating rectifiers because of extensive development programs and adoption of new manufacturing techniques. Price reductions range from 15 to 35 percent.

● First power plant to use delayed coke

Stone & Webster Engineering Corporation has been commissioned by Virginia Electric and Power Company to design and construct the first power plant to use a new refinery byproduct — delayed coke — as fuel. The new dual-purpose station will have a capacity of 165,000 kw. It will cost more than $20,000,000. The fuel known as "delayed coke" will be supplied by the American Oil Company. They are building a large refinery on adjacent property, just east of Yorktown, Virginia. Steam will be supplied by a 1,200,000-pound-per-hour boiler operating at 2000 psi at superheater outlet and an initial temperature of 1000 F with reheat to 1000 F. The turbogenerator is the first preferred standard turbine to be designed by Gener-

al Electric Company in this large size. Three fuels — delayed coke, coal, and refinery gas — will be fired simultaneously. The station will be set up to use 100 percent coal or up to 85 percent delayed coke, as required. Solid fuels will be pulverized. This will be a functional semi-outdoor type power station. A steel structure with corrugated asbestos siding will house the turbine and the firing aisle. Boiler will be outdoors.

● Largest hydraulic turbine for California irrigation

Contract for a 74,500-horsepower, 240-rpm, 1151-foot head, 6-jet vertical impulse-type hydraulic turbine has been awarded by Tri-Dam Constructors to Allis-Chalmers Manufacturing Company. The turbine will be one of the largest of its kind in physical size and capacity in the country. The unit will be installed in the Donnells plant now being developed on the Middle Fork Stanislaus River. Completion of the turbine is scheduled for 1956.

● Kanawah River plant most efficient

The Kanawah River plant of the American Gas and Electric System was the most efficient steam-electric generating system in the nation in 1954, according to recent figures released by the Federal Power Commission. The station boasted a heat rate of 9113 Btu per kwh net generation. Total capacity of the plant is 430,000 kw.

● Coal flows like water

Fine coal can be emptied from a bunker almost as fast and completely as water runs from a tank using a method currently being tested by the Bituminous Coal Research Laboratory. Using an aeration method, great promise is held for applications to industrial and utility plants using small-size coal. In another project, BCR announces plans for a second pilot model of a coal-fired automatic steam generator. The new generator is being designed to handle higher caking coals. An outstanding feature of the unit is the control system, consisting of a simple combination of mechanical and electrical switching equipment comprising synchronous timers, cams, and microswitches. Simplicity is its strong advantage.

● Generation record broken, and will be broken again

Producion of electric energy by utilities reached an all time high of over 503 billion kwh for the year ended June 30. This is the first time that a year's output has exceeded the half-trillion mark.... And a General Electric spokesman predicts that in less than ten years power production in the United States will amount to 1040 billion kwh. By 1964, he expects a 250-percent increase over the 1954 rate of power generation.

● Natural gas becoming the fastest growing primary fuel

A recent survey by Worthington Corporation shows that consumption of natural gas has increased from 500 billion cubic feet in 1920 to more than 6000 billion in 1950. Upwards of 2 million industrial firms are using gas as a major source of energy in their manufacturing operations.

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Air cleaning equipment

500-Dust collection manual

"The Collection and Recovery of Industrial Dusts," 32-page Manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains operation. BUELL ENGINEERING CO., INC.

501-Improved electrostatic dust control

"Dust and Fume Control," 11-page Bulletin G406, tells of the improvements and refinements that have been made in electrostatic precipitation. Also included are background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, the Dualaire dust collector, and the Holo-Flite processor. WESTERN PRECIPITATION CORP.

502-Series on dust and fume collectors

Exhaust fans for dust collecting and air handling are described in Catalog 1002-6. Includes complete performance tables and test curves. Plans and elevations of typical installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities of Norblo bag type, hydraulic type, and centrifugal dust collectors. THE NORTHERN BLOWER CO.

503-Using dust collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrester types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIRK & BLUM MFG. CO.

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Boilers and boiler accessories

504-Complete soot blower data

Bulletin 1137 gives complete information on the Model G9B blower which employs a fixed position rotating element to clean a large number of tubes by sweeping through a predetermined arc. The bulletin suggests various uses. DIAMOND POWER SPECIALTY CORP.

505-Boiler setting and baffle data

More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design, in 20-page Bulletin BW-54. THE ENGINEER CO.

506-Answers to hot water problems

Answers to your hot water problems are given in Booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are discussed and illustrated. PICK MANUFACTURING CO.

507-Package boiler improvements

Seven-page Bulletin AXY-1 gives full operating details and describes changes that have been made in the Amesteam generator, which is factory assembled, for 15 through 200 psi pressures. AMES IRON WORKS, INC.

508-Do your own boiler survey

Here's how to get a boiler survey form without obligation. Write for this bulletin covering the new CB self-contained boiler. Illustrations of installations, cutaway views of the boiler, and articles on how the units have proved themselves in specific applications are included. Four pages. CLEAVER-BROOKS CO.

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of boiler installations. HENSZEY CO.

510-Versatile water-tube generator

Packaged water-tube steam generators, Type MH, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls, are covered in detail in 16-page Bulletin MH3-54. UNION IRON WORKS.

511-How to survey your steam needs

Formulas behind all package steam generators and illustrations of how a package steam generator installation can raise steam capacity without extensive structural changes are presented in Booklet "Sales Steam—2-1." An example shows how to make a professional survey of your own steam requirements. Complete records and two installation case histories are included. Twelve pages. CYCLOTHERM DIVISION, NATIONAL-U.S. RADIATOR CORPORATION.

512-Steam cost calculator

Made of heavy board, this Steam Cost Calculator will enable you to read directly cost of steam per hp for installations using oil, coal, or gas. It also gives a direct reading of efficiency of the system. HAPMAN DUTTON CO.

513-Handbook on startup

Handbook covers washing out new boiler, putting it in operation, handling in service, firing methods, and shutdown. Includes big section of everyday engineering data. Forty-eight pages. TITUSVILLE IRON WORKS CO.

Building construction, materials

514-Glass blocks save all ways

"How to Modernize Old Windows with PC Glass Blocks," seven-page Bulletin GB-104 points out that glass blocks have greater insulating value than sash windows, provide better daylighting, and are easier to clean and maintain. Drawings show how blocks will fit any existing window opening. PITTSBURGH CORNING CORP.

515-Roof drains and installation

Prepared to aid in specification and installation of roof drains, 47-page "Zurn Roof Drain Manual" 54-1 includes engineering drawings showing types of drains to use for specific application. How to install drains in standard open deck parking areas and outdoor recreation terraces is also shown. J. A. ZURN MFG. CO.

Compressed air supply

516-Air switches divert pressure

A broad line of pneumatic switches is available for surface or flush mounting. A gradual switch that slowly increases

delivery pressure is also described in Bulletin 357. Two pages. THE POWERS REGULATOR CO.

517-Are you wasting air?

"A Better Air Power System," Folder 213A points out that power losses in compressed air lines are frequently as high as 30 to 50 percent. It describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. Six pages. INGERSOLL-RAND CO.

Corrosion control

518-Handy protective coating chart

Tables of properties, application techniques, and industrial uses are offered in Catalog 2-55-3M. Twelve pages. AMERCOAT CORPORATION.

519-Meet the film-forming amines

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page Technical Paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. BETZ.

520-Newest paints described

"Subox and Subalox Anti-Corrosive Paint—30th Anniversary," replaces the 25th anniversary issue you have in your files. It covers these paints as previously made and includes the newer varieties. Case histories show successful use of Subox paints on various types of industrial equipment. SUBOX, INC.

Drafting methods, equipment

521-Simplify your drafting practices

Sample drawings of engineered parts and assemblies illustrate the eleven rules (from the use of word descriptions for simple parts to making freehand drawings wherever possible) for simplifying drafting practices. These simplified methods have shown that it is possible to cut the total number of hours required to complete a given volume of work by 40 to 50 percent. Thirty-six pages. AMERICAN MACHINE AND FOUNDRY COMPANY.

Electrical distribution

522-Current-limiting fuse charts

Hi-Cap fuses for the protection of loads above 600 amperes are described in six-page Bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is thoroughly explained. BUSSMANN MANUFACTURING CO.

523-Dry transformer developments

"Latest Developments in Dry-Type Transformers," seven-page Catalog 153-A, presents the advantages of air-cooled units designed and constructed primarily for inside installations. SORGEL ELECTRIC CO.

524-Correct that low power factor

Booklet 50B, 27 pages, describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. SPRAGUE ELECTRIC CO.

525-Outdoor service equipment guide

Designed to make easier the selection of outdoor service equipment, 12-page Bulletin 2016 combines descriptive data on all available standard equipment—service entrance, receptacle type, dual control, three-phase units. A useful guide for all electrical engineers. HEINEMANN ELECTRIC CO.

526-How to choose circuit breakers

All essential information on the selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest prices, dimensions, and ordering instructions—arranged and indexed to reduce

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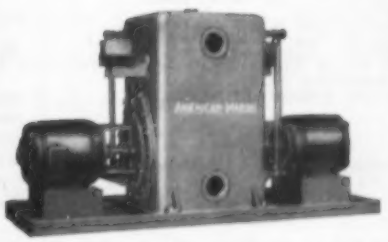

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. . . starts on page 88

reference time and eliminate errors. Sixty pages. I-T-E Circuit Breaker Company.

Electrical utilization

527-Heat with electricity

Industrial electric heating applications and methods are described in 32-page Booklet, "101 Ways to Apply Electric Heat." Illustrated case histories show experience-tested ways to apply metal-sheathed Chromalox electric heating units in industrial jobs. Edwin L. Wiegand Co.

528-Automation through speed control

Colored cross-sections and diaphanous views show how pneumatic control has been designed into U. S. Varidrive motors to increase and improve production output. Bulletin 1882 shows typical automatic control applications. Eight pages. U. S. Electrical Motors, Inc.

529-Complete motor buying data

Complete buying information on standard ac fractional and integral horsepower motors is presented in Bulletin GEC-1026. A special section on selection of integral horsepower motors covers lead requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Information on all motors includes descriptions, and specifications. Twenty-eight pages. General Electric Company.

Fuels and firing equipment

530-Handling heavy fuel oils

"The Heating and Handling of Residual Fuel Oils," eight-page Bulletin 1601, covers heavy fuel oils for use in burners of boilers, furnaces, and processing equipment of industrial and commercial plants and buildings. Use of Preferred Ribbon Heat for heating piping lines is explained. Preferred Utilities Mfg. Corp.

531-Underfeed stokers explained

The latest refinements in single retort underfeed stokers are discussed in 12-page Catalog SB53. Both the fluid ram and gear drive units are described in detail by means of text, elevation drawings, and cutaway views. Erie City Iron Works.

532-Modern ways of burning coal

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. Bituminous Coal Institute.

533-Controls for gas firing

A factual and photographic roundup of how this company's Automatic Combustion Control systems are being used with various types of gas-fired boilers is presented in 14-page Bulletin MSA-116. This booklet gives basic information about the right kind of combustion control practices for gas-fired generators. Hagan Corp.

534-Industrial heating handbook

New handbook provides plant engineers with basic concepts of industrial heat processing and heat control. Pruned of technical language, the handbook goes from a discussion of heat-to-fuel cost comparisons to design elements. Common formulas used in calculating heat and oven requirements are included. Bulletin 555 is a refresher course in process heating. Twenty-pages. Michigan Oven Company.

Heat exchangers

535-Blowoff heat is free heat

Recover practically all of the heat of the blowoff water in a continuous blowoff system. Bulletin 5700 uses diagrams and text to explain how this steam may be used to heat feedwater in an open or deaerating heater and how it may be condensed in a closed heater or flash condenser to heat feedwater beyond the deaerating heater. Cochrane Corp.

536-Heat exchanger operation

Air-flow diagram in two-page Data Sheet 124 graphically shows operation of the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained. Niagara Blower Co.

Instruments and controls

537-Temperature and pressure control

Through years of experience in instrument design and manufacture, this company has developed a specialized line of equipment for the recording and indicating of temperature and pressure. Seven-page Bulletin G-158-A shows typical examples. The Electric Auto-Lite Co., Instrument and Gauge Div.

538-Multiuse temperature regulators

Installation drawings point out how the Spence Type ET150 regulator can be used with an instantaneous water heat-

er, a storage water heater, and a forced warm air heating system. Temperature control by means of temperature regulators that combine both a pressure and thermal element is discussed in Bulletin 1008. Four pages. SPENCE ENGINEERING CO., INC.

539-Automation dictionary

This "Automation Dictionary" covers some 87 words and phrases in the expanding vocabulary of automation. These are not standard engineering definitions but new engineering terms defined for the understanding of the average engineer. MINNEAPOLIS-HONEYWELL REGULATOR CO., INDUSTRIAL DIV.

Lighting

540-Fluorescent lamp handbook

"Fluorescent Lamps and Auxiliary Equipments," eight-page Technical Bulletin LS-101, gives complete data on the Circline, general line, Slimline, and rapid start lamps. Wiring diagrams, equipment for each type of lamp, and equipment for suppression of radio interference are included. Application Engineering Dept., Lamp Div., GENERAL ELECTRIC CO.

Lubrication

541-Do's and don'ts for bearings

A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

542-Oil seal manual

Quick reference manual covers selection, application, and installation of clipper oil seals. Descriptions cover the latest seal designs, including extruded and molded oil slingers and end face seals. Essential data is in tabular form. Twenty-eight pages. JOHNS-MANVILLE.

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Maintenance items

543-Effective tube cleaning

Bulletin 44 introduces a new geared tube cleaner for removing scale in heat exchanger and condenser tubes of ⅜ to 2½ inch ID. The unit is particularly effective where conditions require low speed and great power. AIRETOOL MFG. CO.

544-Boiler cleaning

Four fact-filled pamphlets explain how this company's products will help you solve algae problems, increase boiler effi-

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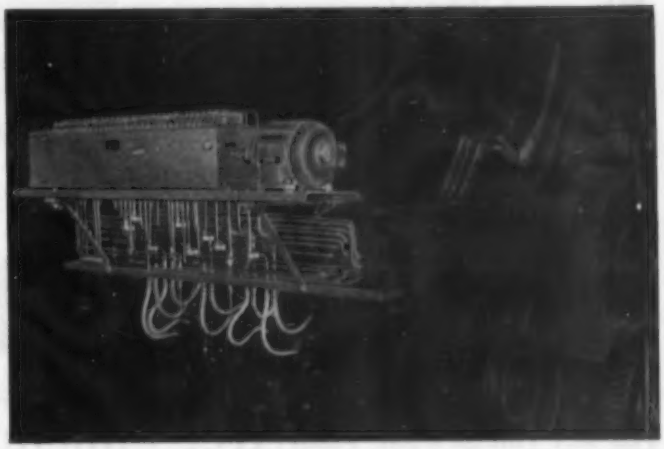

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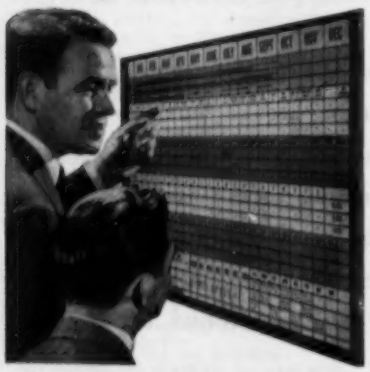

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ciency with use of the Ever Clean boiler process. Remove rust, and prevent corrosion. NORTH AMERICAN MOGUL PRODUCTS.

545-Get up to date on welding

Things you should know about West-Ing-Arc, newest of all MIG welding processes are told in Bulletin B-6525. Physical properties of the welds, cost, and what this process can do for you are discussed. Eight pages. WESTINGHOUSE ELECTRIC CORP.

546-Repair leaks with cement

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. SMOOTH-ON MFG. CO.

Materials handling (bulk)

547-Storage capacity tables

Concrete stave storage bins are discussed in this technical brochure. It contains tables of cubic foot weights of flowable materials, capacities, description of wall construction, test data, and other relevant engineering data. Book is illustrated with many photographs and line drawings. Twenty-nine pages. THE NEFF & FRY CO.

548-Belt conveyor design data

Engineering data required to design a belt conveyor for any application are presented in 86-page Catalog 852. The booklet, published to serve as a handbook on conveyor design, states that many conveyor problems can be answered by using a standardized unit. THE JEFFREY MFG. CO.

549-Story of tile storage bins

"Vitrified Glazed Tile Industrial Storage Bins," four-page Bulletin 1153-B, tells you how this type of bin can keep materials clean, dry, and ready for use. Drawings show how the tiles are constructed and the simplicity of erecting silos made of these tiles. KALAMAZOO TANK AND SILO CO.

Mechanical power transmission

550-Fluid drive selection guide

New fluid drive for general purpose industrial adjustable speed applications is discussed in Bulletin 9419-9519. Advantages and applications are described, emphasizing such factors as speed control, power savings, no-load starting, torque limitation, acceleration control, shock absorption, and simplified installation. Tables indicate the proper fluid drive to use with drive motors rated from 7.5 to 800 hp. Eight pages. AMERICAN BLOWER CORPORATION.

551-Adjustable speed principles

Principle of operation and use of Dynamatic Eddy-Current adjustable speed equipment is described in 16-page Bulletin GB-2. Typical torque and load curves are also given. DYNAMATIC DIV., EATON MFG. CORP.

552-Need a speed changer?

Operating advantages of "Vari-Pitch" speed changers are described in Bulletin 20B6013D. Available in twelve sizes from 1 to 75 hp with output speeds ranging up to 2900 rpm. Speed changers operate in either vertical or horizontal position. Suitable for reversing service with addition of a simple, low-cost tension stabilizer. Includes comprehensive arrangement diagrams, selection and speed range tables. ALLIS-CHALMERS MANUFACTURING COMPANY.

553-Poly-V belt drive characteristics

Design characteristics of the Poly-V drive, a single, endless belt with molded lengthwise ribs, are explained in eight-page Folder 6638. Line drawings and text compare the Poly-V with conventional drives and point out advantages. MANHATTAN-RUBBER DIV., RAYBESTOS-MANHATTAN.

554-V-Belt rating manual

"Multi-V-Drives"—this 100-page master engineering manual presents a scientific and simplified method for rating V-Belts. In addition to accepted theories on V-drive engineering, factors such as small diameter sheaves, centrifugal force, average hours per day operation, and other conditions affecting belt lines have been considered. WORTHINGTON CORP.

555-New gear manual is a must

Illustrations, diagrams, definitions, tables, charts, and explanations regarding all types of gears are offered in Manual G655. For the first time, a simplified method of calculating horsepower ratings of all types of gearing is presented. This free manual is a must for all plant engineers. Seventy-six pages. PHILADELPHIA GEAR WORKS.

Piping, tubing, and hose

556-Stainless steel piping data

Engineers and designers concerned with problems involving stainless piping will find valuable data in six-page Bulletin TB-356. It outlines methods of bending and joining stainless pipe and discusses the problems of light wall versus heavy wall pipe with tables of dimensions and weights of various stainless pipe size schedules. THE BABCOCK & WILCOX CO.

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557-Insulate underground piping

Efficient, permanent, and economical insulation of underground piping is discussed in Bulletin 37-D-2. Includes table of thermal expansion of pipe, and table of heat losses and efficiencies for underground piping. Eight pages. Z-CRETE DIVISION, ZONOLITE COMPANY.

558-Data on pipe fabrications

Specifications for all sizes of pipe from ⅛ to 24 inch in diameter are presented in 16-page Catalog 575C. Tables give data and descriptions of standard, extra strong, and double extra heavy pipe, spiralweld pipe, large OD pipe, line pipe, electricweld tubing, welding fittings and flanges, oil well casing, and water well casing. Facilities for fabricating pipe for structural uses also are discussed. L. B. FOSTER CO.

Pumping equipment

559-Sewage and sump pump selection

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contractors who specify sewage and sump pumps. It describes in detail three types of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. AMERICAN-MARSH PUMPS, INC.

560-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON CO.

561-Centrifugal pump data

Complete information on horizontally split case double balanced suction pumps is given in Bulletin 519-A. Dimensional drawings and Engineering data are included to simplify selection. Four pages. WEINMAN PUMP MFG. CO.

562-Automatic sump pump data

Complete engineering data on a line of sump pumps that covers every application is presented in Bulletin 5530. Submersible sump pumps, vertical pumps, and hydraulic operated drainers are discussed. Four pages. PENBERTHY INJECTOR COMPANY.

563-Bronze pumps resist corrosion

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"Refractory Concrete Manual," 16 pages, covers basic information on recommended practice for mixing and placing refractory concrete. Lumnite Div., UNIVERSAL ATLAS CEMENT CO.

565-How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. BABCOCK & WILCOX CO., REFRACTORIES DIV.

Refrigeration

566-Specifying refrigerant receivers

"Liquid Receivers for Ammonia and Freon," four-page Bulletin LR-1, gives all the information necessary for specifying these units and includes elevation drawings to show typical installations. HENRY VOGT MACHINE CO.

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567-Steam traps and specialties

Catalog 68G, 31 pages, describes and illustrates steam traps, strainers, regulating and reducing valves, separators, and vacuum and lifting traps. STRONG, CARLISLE & HAMMOND COMPANY.

568-Avoid clogging steam equipment

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569-Design of multistage turbines

Smaller framed, multistage turbines are featured in six-page bulletin. Overspeed governor, governor valves, blades, diaphragms, and many other design features are also discussed. TERRY STEAM TURBINE CO.

570-How steam turbines work

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571-Speed control fundamentals

"Fundamentals of Turbine Speed Control," 32-page Brochure H-21, is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate operating principles of actual control systems. ELLIOTT CO.

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578-Demineralization principles

"Demineralization Including Silica Removal by Ion Exchange," 28-page Booklet 3803, describes applications, principles of operation, and gives recommendations for demineralizing and silica removal apparatus and synthetic resins. THE PERMUTIT CO.

579-How to supply your own water

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Industrial Power Systems Handbook, Donald Beeman, editor; McGraw-Hill Book Company; 971 pages; $12.50.

This book is a permanently bound, somewhat condensed version of the General Electric *Industrial Power Systems Data Book*. Anyone who has a copy of the IPS data book already has a more comprehensive treatment of the subject than is represented by this commercially published offspring.

For those not having access to the parent work, the *Industrial Power Systems Handbook* represents as fine a collection of outstandingly useful engineering information as might be found covering this particular realm. While the organization of material is not quite as thoroughly indexed as might be expected of a "handbook," yet the information is there to be easily found. The editor and his 13 cooperating authors are all members of General Electric's Industrial Engineering section. This, of course, slightly colors some of the viewpoint as to what might be "acceptable" practice. This is not to say, however, that the book is lacking in soundness or authority. Quite the contrary. It is deserving of a prominent place on the book shelf of any engineer charged with the responsibility of providing electric power in industrial plants.

High-temperature Corrosion Data; National Association of Corrosion Engineers; 50¢.

This is a tabulation of information on the high-temperature corrosion behavior of 31 materials, ranging from cast iron to lead and including some non-metallics. The data covers a number of stainless steels and high alloys subjected to temperatures over 400 F. Corrosion rates are indicated as "low," "moderate," or "high" versus specific temperatures.

Plant and Process Ventilation by W. C. L. Hemeon, Engineering Director, Industrial Hygiene Foundation of America, Inc.; The Industrial Press; 437 pages; $9.00.

Here is a book aimed straight at the men responsible for ventilation of industrial plants. It is particularly notable for its emphasis on ventilation rates as compared to the more common-place emphasis on duct and fan specifications found in most discussions of ventilation. The author's point is that the ventilation rate is fundamental in determining whether the duct work and fans are doing an effective job.

The typography is quite attractive, though the illustrations are rather ordinary. The book is outstanding in its presentation of tabulated material for easier comprehension. Tables of nomenclature are included, so that there is no doubt about the symbols used in the equations. This should prove to be a valuable book for anyone concerned with ventilation of industrial plants.

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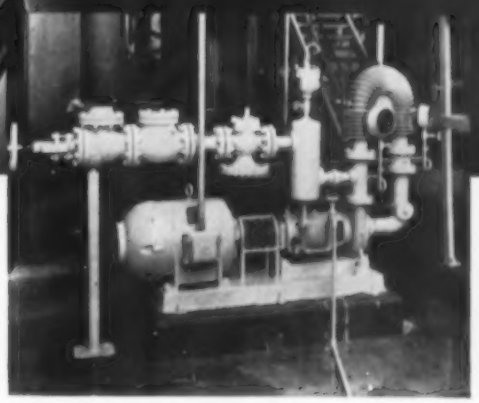

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